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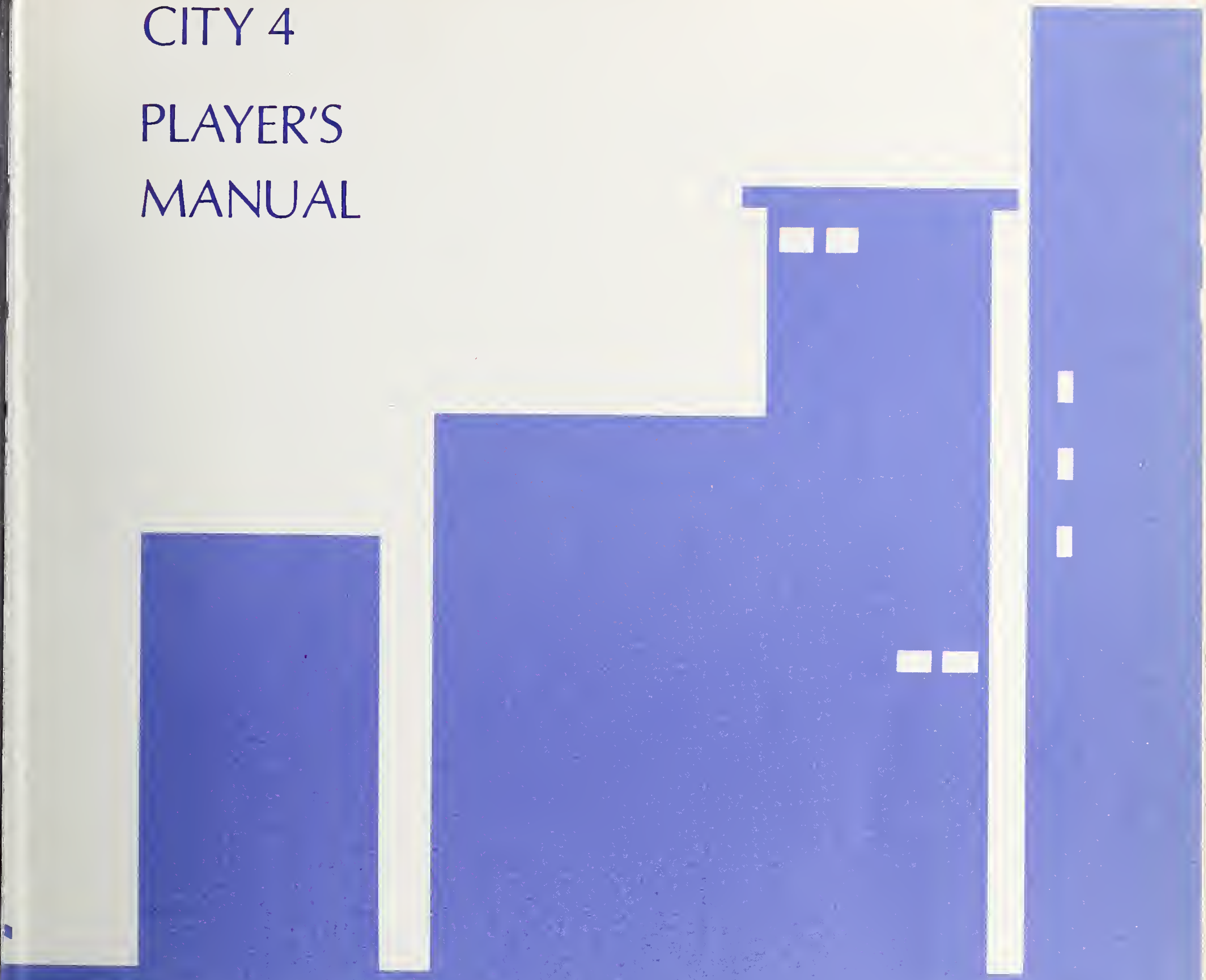
CITY 4

PLAYER'S MANUAL



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CITY IV

PLAYER'S MANUAL

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I. INTRODUCTION

City IV is an operational simulation game in which participants make economic, government and social decisions affecting a hypothetical metropolitan area. Through the use of a computer, the simulated urban system responds to the participants' decisions as any real city would. Each player in City IV is assigned to a team which shares an economic and governmental role. The interrelated decisions made by teams will guide the way the simulated city changes in composition and size.

The simulation approach to cities offers the players an opportunity not only to make decisions but to implement them as well. They receive a feedback from their actions and see the effects from other forces that are constantly at work altering the effectiveness of the players' decisions. Players therefore have a learning experience in how to deal with a changing environment. The round-by-round play gives the players the necessary experience in selecting the type of analysis to move them towards their objectives while the allocation of their time and Game resources is a critical determinant of the success they hope to achieve. As the Game progresses, players learn to increase their involvement in the management of the environment while at the same time learning more about the relationships between business and society.

One of the primary purposes of the Game is to improve the players understanding of urban problems in systemic terms. In other words, the aim is to encourage players to view the activities of the City as being closely related and interdependent (e.g., an unemployment problem will exacerbate a health problem, the loss of industry and jobs in the private sector will reduce the number and quality of services offered in the public sector through reduced tax revenues, etc.). The Game also encourages players to use an interdisciplinary perspective when dealing with urban problems; that is, to look at the problem not only from the viewpoint of an economist, but also from the perspective of a geographer, planner, political scientist, etc.. For instance, if a player is dealing with a land use problem such as zoning, he soon realizes that he cannot escape the broader concepts of land-use planning. The problems of housing, unemployment, education, health, highways, etc., are all related in a system of interconnected activities and institutions to his original land-use problem of zoning. Hence, many of the outputs of this particular gaming model (e.g., land use maps, economic indicator tables, etc.) are designed in such a fashion that the City can be viewed more easily as a single entity than as several separate and disparate parts.

Although no two games are ever identical, most games have common characteristics that are noteworthy. In a typical game, the economic decision makers can best be described as rather conservative and cautious players. This aversion to risk-taking is especially noticeable in the early rounds when players are uncertain as to the outcome of particular decisions. Economic decision makers generally do not have a game plan and most decisions in the early rounds are not made in a systematic fashion or developed in a coordinated manner. In later rounds, many decisions are made as the result of actions taken in earlier rounds. For example, an economic decision maker might build some housing units for rental purposes and then find that they are underutilized. The decision maker might then consider building commercial or manufacturing establishments close by in order to induce more people to live in the underutilized housing units and build up a good supply of labor. Just as likely, the procedure would be reversed, and the emphasis would be on building housing units near a previously built manufacturing plant in order to maintain an adequate supply of labor close to the plant.

The economic decision makers usually make profits on their business operations, although losses on particular investments are not uncommon. It is characteristic of economic decision makers that profit maximization is the primary motive for making decisions, subject, of course, to the twin constraints of risk-taking and uncertainty.

The public decision makers attempt to make a concerted effort to improve the welfare of the City, although the indicators used to measure economic progress do not clearly reflect the intensity of this effort. During the early rounds, a typical game plan is to obtain additional revenue to upgrade the school system and municipal services, while at the same time attempting to redistribute the tax burden to fall more heavily on the business community and to a lesser extent on the work force. Lower income residents generally receive a tax break through the reduction of the sales tax on goods and services while the tax on auto owners is raised in the hope that the use of public transportation will increase.

The social decision makers are the citizens who live and work in the city. They are the voters and purchasers of goods and services needed to complete a real city. The social decision makers serve as the equalizing force to the government and economic systems. Their desire for leisure directly controls the amount of extra work, adult education, politics and recreation that they will participate in. Their voting power and environmental expectations directly influence the course of government. Social dissatisfaction can lead to boycotting businesses and industries as well as schools and municipal services. Their demands influence the type of housing and transportation they will accept which in turn affects all other parts of the municipal system. If city conditions are acceptable to the general population, inmigration occurs and the city grows. Otherwise, outmigration can send the city into bankruptcy if it continues for any duration of time. In short, commercial and government decisions ultimately must satisfy the general population if any city is to survive in the long run.

As in a real city, the public deficit looms as an obstacle in the path of all social reforms. So it is with the City game. The public administrators must face the debt problem and solve it before money can be allocated in significant amounts to create the utopian society we all dream about. These administrative processes that implement social reforms require the integration of decision making through the various disciplines. As the game progresses, the conflict between the objectives of the public and private sectors becomes amplified. Both sectors begin to realize that they cannot perform their objectives independently and the learning process begins. As an example of this learning process, consider the micro-level analysis of shopping centers which are simulated by the "personal goods" and "personal service" industries. To perform this analysis, appraisals are required along with business and property analysis. Investment portfolio analysis is required to manage a variety of business enterprises and a portfolio of real estate resources. The constraints on the entrepreneur come from the public sector in terms of zoning restrictions, building permits, taxes, utilities, etc., which can prove very formidable. Hence, the public and private interests become interwoven and the Game provides a way of demonstrating decision-making in a society where there is a community of interest between the public and private sectors. The inefficiencies of independent decisions become expensive not only to the developers but to the community as a whole, so it becomes evident that it pays to have an improved analysis of the problems of managing the environment in order to achieve public objectives, whatever they may be.

The Players manual is designed to be a reference manual for game players and cannot be read as a text book. This manual is one of a set comprised of a Director's Manual, Player's Manual, and Computer Operator's Manual. It is assumed that players will be given complete instructions in the rules for a particular game play by the Game Director who is experienced in running this particular game. Individual players will use only those portions of the manual that are applicable to their game role.

In the playing of the actual game, participants assume various roles in the public and private sectors as outlined in the players manual. A Game Director who is familiar with the Game in detail begins the Game with a classroom type lecture devoted to the discussion of the major decision-roles in the City Model as well as the many printouts and reports that result from each role player's decision inputs. During this session, players are assigned a particular role (i.e. economic decision maker, mayor, school board member, etc.) and asked to read that portion of the Player's Manual dealing with his role. Using the manual as a technical guide, the players address themselves to the mechanics of coding forms and interpreting the computer printouts. It is at this time that the Director describes the preprogrammed city in the computer to the players. The Director has the option of choosing initial parameters such as economic growth rates, social conditions, production capacities, etc. to suit the particular objects of the players and thereby making the Game more flexible and susceptible to innovative approaches to urban problem solving. The Director can structure the role assignments to be directed at individuals who concentrate on single objectives such as heavy industry to multi-disciplinary task forces to consider urban problems within an interdisciplinary framework (e.g., a task force on transportation policy might include a sociologist, political scientist, geographer, planner, engineer and an economist).

With initial roles established, the game beings. The Director generally starts the game by discussing possible objectives with each player or group of players along with the present or initial city conditions. For example, if the Director chooses to use the planning-programming-budgeting systems approach, each player or group of players must:

1. Define his general Goal which is Output Oriented.

2. Identify objectives which indicate conditions or levels which must be obtained or maintained to successfully reach the designated Goal.

3. Draft Programs which are designed to achieve the standards set by the various objectives.

4. Evaluate the Programs to determine their effectiveness (in cost/benefit terms) as compared to alternative programs.
Consider a political role in the urban system that is abstracted as follows:

Political Goal: School Department
Develop a school system comparable to the best in the nation, which will provide high quality, accessible and meaningful educational experience to the City's population.

Objective #1
Maintain the pupil/teacher ratio at less than 21/1.

Program #1
Using the population growth projections, determine future student levels. Hire middle and high income teachers, at the optimum mix, to meet this demand.

Program #2
Redistrict school boundaries to better utilize existing City resources.

Program #3
Construct new schools or add to existing facilities as projected. (Specific round-by-round projections are used.)

Objective #2
Keep unmet demand for adult education at less than 10% of the total demand.

Program #1
Use the population growth projections, determine future student levels. Hire middle and high income teachers, at the optimum mix, to meet this demand.

It can be seen that the School Department has:

1. A definite goal (to be the best)
2. Identified meaningful standards of performance (student/teacher ratio of 21/1 and unmet demand for adults at 10% or less)
3. Determined approaches to achieve these standards (population projections, new construction, redistricting, etc.)

The previous example of the School Departments (see page 59) political goal could apply to most school systems in any City. We all want low student/teacher ratios and the best possible teachers for our children. New construction, better utilization of facilities and adult education programs with the most competent teachers available is certainly a laudable goal. The only obstacle to this utopian dream is that other government department have their dreams and all departments compete for the lion's share of limited tax dollars. Besides education, the government sector (see page 48) must consider the problems of budgeting, taxation, assessment and bonding (see page 48), highways (see page 75), fire and police protection (see page 65), planning and zoning (see page 76), utilities and bus and rail transportation (see page 91). Departments make decisions which include allocating capital and current funds, changing salaries and maintenance levels, requesting Federal-state aid, changing district boundaries, constructing or demolishing public buildings and changing levels of service.

In the game, all of the above roles are enacted by various players who strive to optimize their goals just as in the example of the school department. Collectively, the Government players work from a tax base that is continually being attacked by the tax payers as excessive and yet their very employment is insured by the elective process which, of course, is determined by the same tax payers who are continually demanding more services from the government. The source of government revenue is taxes which are levied on the population just as in a real city. Other players must assume roles in the city's economic sector to create employment for the population. The activities of the businessmen must include the operation of the industrial, commercial, and residential establishments which in turn require land purchases and sales, salary changes, maintenance level alterations, business goods and services, purchases for operating exigencies, boycotts of commercial firms, acquisition of long and short term loans, and constructing, improving and demolishing businesses.

The commercial activities (see page 9) are subdivide within the game into Basic Industries, Construction Industries, Commercial Activities and Residences. The Basic Industry includes heavy and light industries and national services (including Standard SIC classes) which spend money for business goods and business services, utilities, a labor force, transportation and above all taxes. The Construction Industry (see page 22) builds and/or demolishes other developments and firms from outside of the local area may also perform construction work. Commercial activities spend money on many of the same items as the basic industry in order to maintain a level of service capacity. This service capacity is available to serve local customers. Finally, the residences, (single-family, townhouse, and highrise) spend money on goods and services, utilities, taxes and earn income based on rent charged and the number and type of occupants residing in their housing units (see page 29).

The social sector (see page 36) is concerned with the income and expenditures of the population (see page 36), the dissatisfaction (see page 38) of the population in terms of housing, personal situation in the community, employment, and the amount of leisure time they can afford. Migration (see page 39) considers the movements of population in and out of the city. Finally the social sector members vote (see page 40), Boycotts (see page 41), allocates their time for work and play (see page 41) and sets the dollar value on their time (see page 46).

The City model selected for game play may be a typical city or it may be the player's own city. The model employs a grid board (see page 2) geographical map that can be loaded with data from any regional or metropolitan area. The map contains 625 parcels in which each parcel represents one square mile of land. Many of these land parcels are unowned at the beginning of play and those that are occupied are represented by a specific, representative land use. For instance if a square mile consists mainly of middle income residences, this parcel would be designated as such even though there could be a few commercial businesses within the square mile. The only requirement to assigning parcels is that the assignment typify the most representative land use. In a similar manner highways and roads are represented along the boundaries of the parcels. If you imagine a parcel as represented by a square, then a road is described as one or more sides of the square.

Once the representations are made, there remains the task of assigning numerical values and indexes to the many parts of the city's functions. For example, when various types of businesses are identified, they must be labeled with their dollar volume and prices for their products. Residences must be identified as to type and amount of rent paid. Voter registration and social dissatisfaction indexes must be established along with zoning classifications, cash availabilities, government expenditures, taxes road configurations and utilities and the election of city officials. These inputs along with the parcel classifications describe the starting city. The files of this starting city are stored in the computer and can be altered by the game director to suit the players needs (see Director's Manual). Changes in these files may affect the output of the computer but will have no bearing on how the computer calculates the output. The computer program directs the computer to act upon the data files in fixed relationships using the various data stored in the city file. In this way the computer can respond to updated file changes, act as an outside system, perform routine functions or processes that would be time consuming for the players and finally act as a bookkeeper (see Computer Operator's Manual).

At this point the game is ready to be played. Each player studies his printout generated from the starting city to evaluate his status as an individual and as a team member. Each team defines its specific problems, establishes objectives and develops strategies. Various groups will then gather for informal sessions for the purposes of bargaining, trade-offs and consumating deals. Eventually each group arrives at final decisions for actions to be taken in that particular round of the game.

These decisions are then entered into the computer by a special code and the model is ready to run. The computer then prints out a new series of data representing the changed city.

In a typical game play the players generally behave in a predictable way with a minimum of player interaction early in the game. Players tend to feel that most interrelations should be avoided for the sake of secrecy. Most players use the guise of ignorance when talking to their peers early in the game and their contacts are limited to attempts at acquiring knowledge. As the player's command over the technical content increases, so does his awareness of the necessity for a properly functioning system. The player realizes that his economic aspirations will not be achieved unless his public counterpart can create a suitable "service-rich" environment in which he can operate. Typically, one or two players generally emerge quickly with an extensive grasp of the system and its technical content and assume the role of educator. In a fashion similar to the old ward politicians, the educators disperse favors (the patronage in the form of technical explanations), to gain the initial respect of his constituents. Needless to say, it is then a simple matter for the educator to insure his election to the mayoralty of the City.

As time passes, other players come to understand their role and the role of others and begin to realize that the mayor, although helping the city to function, often is insuring his own economic prominence at their expense. At this point, the era of the ward politician is inevitably (or generally) over and with this passing comes the emergence of the city-manager. The political cooperation that grows from the new regime eventually leads to a full appreciation of the efforts of others and will open up higher levels of discussion concerning city-wide urban problems. Although the previous discussion concerns player behavior during game play, the influence of the gaming process has created a learning experience is one of the fundamental purposes of City Games and these experiences with the game can be transferred to the problems of the real city.

In most games, the Game Director's role diminishes as the play progresses and players become more familiar with the technical content of the game. Since bribes and boycotting are allowed along with collusion and other forms of special interest groups, a new aspect of the game appears, namely law and order. Players rapidly learn that disputes cannot be settled by opposing interest groups and the enforcement of agreements and compromises becomes almost impossible. Players demand legal systems and police departments and the local government is faced with new expenses to deal with. If these demands are met, the City managers must generate more income to meet these expenses and forego other spending plans. At this point, the hypothetical city is becoming very real and very complicated to run. Even though it is a hypothetical city, players become emotionally involved and the intensity of their involvement permeates the playing area. Time is a constant enemy for the players just as in real life. Everyone wants everything at once and a typical game play allows the players about two to three hours per round to make their decisions. One round of the game is equivalent to one year of real time. If elections are required every two years, only two rounds are played before new elections. If the newly elected officials fail to honor prior commitments by their predecessors, well, the best laid plans .....!

It is within this framework that the City IV manuals are written. There are three manuals for City IV; a Director's Manual, a Players' Manual, and an Operator's Manual. The Director's Manual is designed to explain the technical content of the computer program including term definitions, programming change procedure and the numerous technical details associated with the game. It is assumed that the Game Director has been taught the gaming operations prior to assuming the Director's role and will use the manual as his primary reference source rather than a set of instructions for running the game. The manual further assumes that a Director has had training in Fortran programming and understands formatting and coding in addition to being knowledgeable about Urban problems. The Director designs the initial city conditions for the start of a game. The manual provides initial conditions for a typical city and specific computer commands for altering these conditions.

The Players' Manual is also designed to be a reference manual and not a text book. The complexity of the game requires extensive reading on the players part prior to the start of a game or selective reference material which is coordinated with the Director's introductory lectures and possibly monitors who are trained in the gaming procedures and will coach the individual players when required. This latter approach has proven to be the most effective method of training players. If past games are indicative, individuals seem to learn their roles much faster when coached by a monitor during actual playing conditions as opposed to concentrated reading and memorizing prior to the start of a game. It is not presumed that players have prior knowledge of this game or even simulation in general. The game is designed so players do not need to know computer programming or how to operate the computer. These functions lie with the Director and the Computer operator.

The Operator's manual is written for an IBM 360 and presumes that the operator knows how to write Job Control Language Programs, use System Utility Programs and Access Data Management Facilities. This manual explains the relationship between the programming data, the taped program and the operation of the computer. Test sequences are given along with a detailed explanation of the existing JCL and File Management Programs and error messages. It is not required for the operator to understand the Director's or Players' role but only to be knowledgeable in operating the computer.

In general, the game should be played with at least 50 players utilizing a large room where players can move freely about. Computer printouts are usually taped on walls for easy access by all players. An optional display would be a gaming board for visual display of the city. The board is marked off in grids to conform to the City map and plastic playing pieces are used to represent the various types of buildings. Colored tape is used to mark off highways and boundaries. Human interest is added if one player agrees to become the Big City News editor. The idea is to subtly report on the good and bad features of the game play in a humorous way. The Game Director reports the results of each round to the news editor who proceeds to write this paper and distribute it before the players learn the results of the round. The detailed computer outputs are then distributed to the players so that they may learn how well their particular game plan went. In other words, the paper presents the overview and the computer reports on the specifics. This method allows the Game Director to concentrate his time on selected areas rather than all areas at the end of each round.

In addition to the normal problems of the City, the Gaming Model can be used for more sophisticated analysis. The Economic Base can be investigated to determine the causes of a changing growth rate along with identifying the components of the economic base. Business cycles can be explored since they are dependent upon sales of goods and services outside the local economy and must be supplemented by an analysis of the condition of the National economy. This provides a useful yardstick for measuring economic performance. By charting the prices for basic industry output, the return on investments and the interest rate on loans and bonds, the players can determine which phase of the business cycle they are in, which in turn, would partially explain capital investment attitudes.

Other basic studies important to public and private decision makers concern the tracing of population growth and projecting future levels. Trends in employment (total), employment distribution by industry, unemployment rates and income distribution are available and in a usable form in the City's output. Here again a PPBS format would guide the player in assembling the pertinent facts and disregard peripheral information.

Housing market analysis becomes important in any geographic area where dwelling units are in competition with one another as alternatives for the users of housing. This problem incorporates many of the previously mentioned types of analysis: economic base, employment trends, income distribution and population analysis along with the additional component of housing stock or inventory. The magnitude of the total housing stock in terms of dwelling units, reflecting changes over time, is one of the most significant indicators of city growth coupled with a changing distribution of the inventory by structural type. Equipped with this knowledge plus an awareness of vacancy rates, rents, property values and financial market conditions, the private developer could make a rational decision as to the advisability of a housing investment.

Appraisal theory can be utilized to aid prospective purchasers and sellers as to the market value of particular parcels of land. The data needed to apply to the cost, income and marketing approaches to appraisal theory is available on the various output sheets supplied by the game.

The problems of social reform can be explored in terms of social dissatisfaction and leisure time demands. Social players determine the amount of money they will pay for transportation and a variety of experiments in public transportation can be tried. Since the social players are the voters, political boundaries and voter redistricting are viable possibilities within the gaming framework. The problems of slum clearance and urban renewal in general are an integral part of game play and many ideas can be tested utilizing the game.

The above are only examples of types of game play because each time a game is played, it is structured to meet the needs of the particular group of players. Players can be richly rewarded with a learning experience that can be applied to real city problems. The variety and combinations of gaming situations are endless just as in a real city. The players themselves insure that no two games are identical because individual player's are not identical. In this sense, City IV is a teaching game that portrays the abilities of the particular players to manage a city.

II. MODEL PROCESSES

A. The Computer

The computer performs several major functions in the City Model.

First, it stores all the relevant economic, social and governmental statistics for the area; updates data when changes are made; and prints out yearly reports.

Second, the computer acts as an outside system, simulating decision-makers, influences and markets that are outside the local metropolitan area. For example, the computer simulates both a national business cycle and the probabilities of federal/state aid. It also determines interest rates on most loans and rates of return on speculative and conservative investments made by players.

Third, the computer performs certain routine functions or processes that would be time-consuming if the players themselves were to perform them. For example, the computer assigns workers to jobs under the assumption that workers will attempt to earn as much money as possible. Other processes include assessing all property, assigning buyers of goods and services to shop at particular commercial establishments, assigning children to public or private schools based upon the capacity and quality of the public schools, and assigning population units to residences based on their desirability. The computer also simulates the migration cycle which moves population units into, out of, and within the metropolitan area in response to the attractive and/or unattractive features of the area.

Finally, the computer acts as a bookkeeper. It records all the transactions of players, deducts their expenditures and adds their incomes to their financial accounts.

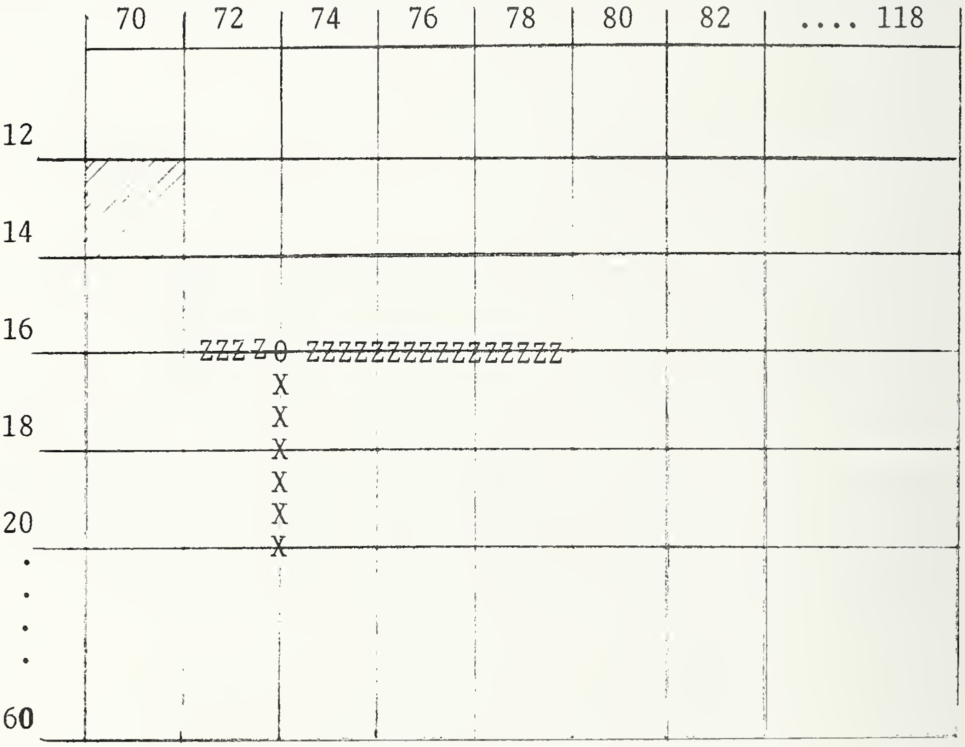
The computer does not have a large vocabulary. Thus, players must write their decisions or questions in a language developed specifically for the computer. This language is an abbreviated code which the computer can accept and act on. For example, when decision-maker A representing the economic sector wants to change a salary or rental figure, he will write $CVPT/#A/S for salary or $CVPT/#A/R for rent instead of the entire word. In addition to using this coded language, all information must be fed into the computer in a certain order. This format must be followed when sending information to the computer or in asking questions of it. It generally requires that a player fill in certain blanks on the input decision form before the information is put into the computer.

B. The Game Board

The City Model's metropolitan area is represented on a game board consisting of 625 squares. Each square represents one square mile of land. Many of these land parcels are unowned parcels at the beginning of play. Unowned parcels may be purchased and developed by decision makers during the course of the game. As players continue to play City over the course of several rounds, the physical changes inherent in all cities will be visible on the playing board.

The game board and all computer maps are keyed to a coordinate system of even numbers. Each square mile parcel can be identified by its coordinates. Horizontal coordinates range from 70 to 118 and vertical coordinates range from 12 to 60. Intersections are identified by odd numbered coordinates and highways are identified by even odd (east-west) or odd even (north-south) coordinates. In all cases, the horizontal coordinate (i.e., the large number) is identified first.

For example, in the map below the shaded parcel is identified as 7014. Further, the four mile highway indicated by ZZZ is identified as 7217, 7417, 7617, and 7817, while the two mile highway indicated by XXX is identified at 7318, 7320. The intersection marked by 0 is located at 7317.



C. The Three Sectors

As already stated the City Model contains three basic decision making sectors: economic, social and government. Every city contains these three vital sectors whose interactions cause the city to either grow and prosper or stagnate and decay. Decisions made by one group ultimately affect others and one group often works against another group to achieve its goals. For example, proposed commercial developments by an economic group in a predominantly residential area can be blocked by residents of that area just as proposed changes by the government sector can be opposed by those participants in the economic or social sector. In light of this, the City Model has the facility for such social reaction strategies as strikes, boycotts, and voting and economic pressures such as bribes.

1. The Economic Sector

The activity in the economic sector is that which gives any city one of the basic reasons for existence. Economic decision makers are those businessmen who operate industrial, commercial, and residential establishments. Upon receiving output at the beginning of the round, economic decision makers review their economic status and make decisions for the present round. The various economic activities in City IV have the following characteristics:

a. Basic Industry

Heavy Industry (HI), Light Industry (LI) and National Services (NS) spend money for business goods and business services, utilities, a labor force, transportation, and taxes. The HI and LI types of Basic Industry are further classified into seven SIC for HI and four for LI. The HI categories are as follows:

HI - Heavy Industry
  FL - Furniture and lumber
  SG - Stone, clay and glass
  MP - Primary metals
  MF - Fabricated metals
  NL - Non-electrical
  EL - Electrical machinery
  TE - Transportation equipment

LI - Light Industry
  FO - Food
  TL - Textile, apparel and leather
  PA - Paper
  CR - Chemicals, plastics, rubber

In order to influence the production of industrial output to be sold to the national business conditions (the computer), owners of basic industries can make a wide variety of decisions. These decisions include purchasing land, changing salaries or maintenance levels, boycotting business goods and business services establishments, acquiring loans, building new businesses, upgrading existing businesses, or demolishing old ones.

b. Construction Industry

A CI can build, upgrade and demolish any economic development (except a CI) in addition to schools, municipal service plants and highways in the government sector. The owner of the CI specifies the price at which a job will be performed on the basis of the equipment, materials, labor and transportation required for that job.

In some cases the game will be played without the construction industry, and firms from outside of the local area will perform all construction.

c. Commercial Establishments

Business goods (BG) and business services (BS), personal goods (PG) and personal services (PS) spend money on many of the same items as basic industry in order to maintain a level of service capacity. This service capacity is consumed or partially consumed by local customers which include Heavy Industry (HI), Light Industry (LI), National Services (NS), other commercial establishments and the population units (P1's) who live in the city. Owners of the commercial establishments may make most of the decisions that owners of basic industries make in addition to setting prices for their products.

d. Residences

Single family (RA), townhouse (RB), and highrise (RC) residence units spend money on personal goods and personal services, utilities, and taxes, and earn income based on rent charged and the number and type of occupants residing in their housing units. Owners of residences may make the same types of decisions made by owners of basic industry in addition to setting the rent paid by their tenants.

2. The Social Sector

Decision makers in the social sector represent the citizens who live and work in City. People are simulated in terms of population units (P1's). Each population unit represents 500 people. However, population units are divided into three socio-economic groups; high income (PH), middle income (PM)and low income (PL). Because each class possesses its own expectations and behavioral patterns, each will prefer different types of residence, job, and schooling, etc. Social decision makers can vote on behalf of the P1's which they represent. Voting power is dependent upon the number of population units controlled, the number of registered votes in each, and their socio-economic class. Social decision makers can also direct the population units under their control to boycott places of employment (HI, LI, NS, BG, BS, PG, PS, Schools, Municipal Services) or shop (PG), PS) locations. Social decision makers can also allocate leisure time of their population units to be spent in any of four basic activities: extra work, adult education, politics, and recreation. The amount of time spent on each of these activities has an effect on the socio-economic status and/or the dissatisfaction index of people living within the city. Social decision-makers also set a dollar value for the time which they spend traveling to and from work. This affects the mode of transportation to which they will be assigned by the computer.

3. The Government Sector

In the City Model the government sector deals with the problems of education, highways, fire and police protection, planning, zoning, utilities, and bus and rail transportation. The government sector is divided into two basic components. The first component includes elected officials: the Chairman and the Council. These officials are elected by the social decision-makers representing the people who live in each jurisdiction. The Chairman and his council set tax rates, approve budgets, grant subsidies and appropriations, and make appointments. Appointed officials named by the Chairman are heads of these live governmental departments: Schools (SC), Municipal Services (MS), Highways (HY), Planning and Zoning (PZ), and Utilities (UT). The Bus and Railroad Companies are semiprivate organizations which also may be appointed by the Chairman. Players representing these departments make decisions which include allocating capital and current funds, changing salaries and maintenance levels, requesting federal/state aid, changing district boundaries, constructing or demolishing public buildings, upgrading public buildings, changing levels of service, and transferring cash between accounts.

D. How to Begin a Play of the City Model

At the beginning of the City Model game, participants will be divided into social and economic decision-makers. These decision-makers will then nominate candidates for the offices of Chairman and Council. Social decision-makers will then vote. Whether an election by simple majority or plurality is at the discretion of the players. The victorious chairman then appoints his bureaucratic officials to make up the rest of the government sector. Players will then receive output which explains the status of their various functions. Upon receiving output, players may then begin to interpret it and think of decisions and courses of action that may solve their problems.

E. The City Model Round

In the City Model, a round represents a year of change in the life of the simulated area. From the standpoint of the participants, however, a round may be thought of as a decision-making cycle which starts when they receive output and ends when they feed their decisions to the computer.

During the early part of a typical round, decision-makers will be simultaneously reviewing their computer output and attempting to organize their possible actions. Economic decision-makers, for example, will probably bid on the various unowned parcels of land and attempt to acquire desirable land from other participants. They may attempt to secure loans from local or outside sources, apply for zoning changes, request utility expansions, and increased highway access. At the same time, social decision-makers might be bargaining for higher wages, requesting improvements in local schools and municipal services, and trying to promote those politicians who are for a favorable platform in the upcoming elections.

Meanwhile, the governmental decision-makers may be receiving requests from the economic and social decision-makers to lower taxes, improve schools, provide better municipal services, expand highways, build additional utilities, enlarge the park system, and improve other services. Budget officials are faced with the task of finding additional revenue to meet expanding public needs and dividing appropriations among the many local departments, all of which have attempted to justify their expanding budgets.

Toward the middle of the round, it becomes clear to many decision-makers that all of their requests will not be granted. Thus, trade-offs and bargains must be made. Elected officials will begin to worry about staying in office. Departments must plan to operate with less funds than they had requested. Low income representatives begin to make their political power felt. High-income representatives attempt to maintain their status. Businessmen begin to look for short-cuts to reduce their losses and increase their activity and profit-making ventures.

As the round approaches a conclusion, the participants formalize the bargains they have made, continue to feed their decisions into the computer, terminate the negotiations on new wage levels, new prices and new rents, carry on their boycotts and complete any other possible actions. When the round ends, participants campaign and carry out new elections, hold town meetings, debrief their actions, and develop new strategies while the computer is performing its functions and preparing new output on the status of the simulated city.

F. Organization of the Player's Manual

Chapters III, IV and V of this manual are organized to present basic information for each decision-making sector. This information includes the numerical parameters for each sector as well as a description of the types of decisions that may be made.

Chapters VI, VII and VIII represent the "cookbook" sections of the manual. The "cookbook" sections are designed primarily for easy reference during the course of a round when players need additional information. Chapter VI describes the computer output with which the players will be dealing. Chapter VI considers the mechanics of filling out input decision forms so that decisions may be accepted by the computer in the proper manner. Chapter VII includes the Master Sheets which summarize all the numerical parameters of the City Model.

III. THE ECONOMIC SECTOR

A. The Economic Decision-Maker

The Economic Sector of the City Model represents the private and entrepreneurial functions of an urban system. An economic decision-maker (represented by A, B, C, etc.), is distinguished from other sector participants of the City Model by the fact that he owns things. He owns land, for example. Some of this land is developed and some is undeveloped. His ownership of developed land gives the economic decision-maker the responsibility of operating the developments which are built there. Another asset of the economic decision-maker is cash. Each economic decision-maker begins playing the City Model with a cash balance. He may use this balance to acquire new land, build another new business, upgrade old ones, invest in venture capital and others. In a sense, the city's economic activity provides a rationale for its existence and its dynamic growth and future development. In the City Model, therefore, the economic decision-maker is not only an individual concerned with maximizing his own profit, but he is also a person whose decisions, biases and judgments will greatly influence and change the simulated area.

B. Economic Land Uses

There are eleven types of economic land uses in the City Model. Each of these land uses represents a development which is owned and operated by an economic decision-maker. These land uses are divided among basic industry, construction industry, commercial establishments and residences. They include:

Basic Industry

- HI - Heavy Industry
    - FL - Furniture and Lumber
    - SG - Stone, Clay and Glass
    - MP - Primary Metals
    - MF - Fabricated Metals
    - NL - Non-electric Machinery
    - EL - Electric Machinery
    - TE - Transportation Equipment
- LI - Light Industry
    - FO - Food
    - TA - Textiles and Apparel
    - PA - Paper
    - CR - Chemicals, Plastics and Rubber

- NS - National Services
    - insurance, consulting, etc.

Construction Industry*

- CI - Construction
    - building, upgrading, demolition

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*As noted earlier, in some plays of the game the construction industry will not be used.

Commercial Establishments

BG - Business Goods
intermediate products, raw materials, etc.
BS - Business Services
computer, accounting, legal, etc.
PG - Personal Goods
food, drugs, appliances, etc.
PS - Personal Services
banking, restaurants, etc.

Residences

RA - Single family housing
RB - Townhouses, garden apartments
RC - High-rise apartment buildings

C. Common Characteristics of Economic Land Uses

All economic land uses share certain common characteristics. These characteristics are development level, land requirements, value ratio, depreciation, maintenance level, and utility requirements.

1. Development Level

The development level for a particular land use represents the size and the number of buildings which make up a certain industrial, commercial or residential development. Development levels range from 1 to n for all land uses. The integer number, n is the ratio of total % of land available for development usually 100% to the percent of land required for one level of development of a particular land use., i.e. for all residential land use 2% of the land is required for a level one development. Hence, maximum level of development is $\frac{100}{2} = 50$. On the parcel notations, development level appears as the number to the right of the land use abbreviation. For example, an FL3 is a heavy industry, furniture and lumber plant of the third level of development.

Development level is included as the characteristic of economic land uses because the number representing a development level is a multiplier by which to determine other numbers throughout the book. For example, you will discover that an FL1 occupies 28% of a square mile parcel. To determine how much land an FL3 occupies, you merely multiply 28% times 3. The same holds true for other numbers, such as those representing employees required, typical construction costs, purchases of goods and services, design capacity, etc.

2. Land Requirements

All economic establishments occupy a given amount of land on a square mile parcel. The amount of land required for a particular establishment varies by its type and level of development. Land requirements for the eleven land uses in City Model are listed below:

Land Use	Land Requirements (Percent of Square Mile Parcel)
FL1	28%
SG1	40%
MP1	48%
MF1	20%
NL1	15%
EL1	12%
TE1	12%
FO1	20%
TA1	6%
PA1	16%
CR1	28%
NS1	12%
CI1	20%
BG1	12%
BS1	10%
PG1	12%
PS1	12%
RA1	2%
RB1	2%
RC1	2%

3. Value Ratio (VR) and Quality Index (QI)

Value ratio is a measurement of the physical condition of a building. It ranges from a high of 100 (a newly constructed or restored building) to a low of 0 (a completely deteriorated structure -- worse than a slum). VR is defined as the ratio of the present value of a development to its original value. Value ratio affects the output or capacity of a business, i.e., a value ratio of 50 means that output or capacity will be 50 percent of what it would be otherwise.

VR applies to all buildings except residences. The physical condition of residences is measured by a quality index (QI). Like VR it also ranges from 0-100 but new residences may be built at one of seven different QI's (40, 50, 60, 70, 80, 90, 100). All other developments must be constructed at a VT of 100.

4. Depreciation

The value of all economic developments decreases during each round of play of City. The rate at which a development depreciates is determined by (a) the normal annual depreciation rate (i.e., time), plus (b) the amount of depreciation caused by the quality of the municipal services[1/] serving the parcel on which the development is located, and (c) for commercial establishments only, the depreciation caused by overuse. Another optional factor of depreciation is flooding which can be initiated by the game director i.e., the outside system. See Master Tables. The following table (page 21) shows depreciation for the land uses in City Model.

5. Maintenance and Normal Operation

Since developments depreciate at a rate which is specified as a percent of their original value, the most striking result is a decreasing value ratio (or quality index). The owner of building may maintain it at a specified value ratio (or quality index) by specifying the maintenance level (0-100) at which he wants the development to remain. The costs of maintaining the value ratio of a building at a specified level are automatically deducted from the balance of the economic decision-maker by the computer. The costs of maintenance of a development involve purchases of goods and services. Basic Industry, Construction and Commercial Establishments all buy business goods and business services. HI, LI, NS, and CI can buy these goods and services at competitive prices from BG and BS establishments within the system or from the Outside System at fixed prices of $130,000 per unit of BC or BS. BG and BS establishments, however, cannot buy goods and services from themselves. Their maintenance costs are, therefore, taken up in purchase at fixed costs from the Outside System, and RA, RB and RC do not require business goods and services either from PG and PS establishments within the system or from the Outside System at fixed prices of $13,000 per unit of $13,000 per unit of PG or PS. BG, BS and PG, PS requirements for 1% maintenance or renovation (of original value ratio or quality index) are summarized in the table on page 22.

[1/] Municipal Services (MS) is a governmental department in City Model. Its main function is to provide services such as police and fire protection to the community. The quality of services which the MS department provides influences the rate at which the value ratio of a development declines over time.

DEPRECIATION FOR THE LAND USES IN CITY MODEL

Land Use	Annual Rate of Depreciation (percent of original value ratio or quality index)	Plus Function of MS Quality	Plus Function of Use
FL1	3.0	3.0 Q*	None
SG1	2.0	2.0 Q*	None
MP1	4.0	4.0 Q*	None
MF1	3.5	3.5 Q*	None
NL1	3.0	3.0 Q*	None
EL1	4.0	4.0 Q*	None
TE1	5.0	5.0 Q*	None
FO1	2.0	2.0 Q*	None
TA1	1.5	2.0 Q*	None
PA1	1.5	2.0 Q*	None
CR1	3.0	3.0 Q*	None
NS1	3.0	3.0 Q*	None
CI1 (equipment)	None	None	4.0
BG1	1.5	2.5 Q	1.5 C**
BS1	2.0	3.0 Q	2.0 C
PG1	1.6	2.6 Q	1.6 C
PS1	2.2	3.2 Q	2.2 C
RA1	2.0	2.0 Q	None
RB1	3.0	3.0 Q	None
RC1	4.0	3.0 Q	None

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* $Q \text{ is } \frac{\text{MS Use Index} - 100}{100}$

** C is (actual use of commercial establishment/design capacity of commercial establishment)

Q and C have no effect if negative

REQUIREMENTS FOR MAINTENANCE OR RENOVATION

Land Use	Maintenance Requirements; Purchases from:		
	BG	BS	Outside
FL1	10 units	2 units	
SG1	8 units	1 unit	
MP1	10 units	4 units	
MF1	8 units	4 units	
NL1	8 units	4 units	
EC1	6 units	4 units	
TE1	10 units	6 units	
FO1	5 units	2 units	
TA1	4 units	2 units	
PA1	4 units	2 units	
CR1	4 units	5 units	
NS1	1 unit	4.0 units	
CI1	10.5 units	1.5 units	
BG1			$250,000 (fixed cost)
BS1			$100,000 (fixed cost)
PG1	2 units	1 unit	
PS1	.75 unit	.25 unit	
	PG	PS	
RA1	.7 unit	.3 unit	
RB1	4.0 units	2.0 units	
RC1	17.0 units	8.0 units	

Now for an example. Let us suppose that economic decision-maker A owns an HI with a value ratio of 90. Suppose it depreciates at 5% (remember, depreciation is expressed as a percent of original value ratio. The original value ratio of a HI has to be 100 -- it cannot be built below that). If A has specified a maintenance level of 90, the value ratio of the HI which he owns will remain 90 in the next round. The requirements for maintaining it at 90 would be 45 units (BG) and 7.5 units (BS). In effect, economic decision-maker A is countering the natural effects of depreciation, which, had he not specified a maintenance level of 90, would have forced the value ratio to have fallen to 85.

All land uses except residences also require BG and BS for normal operation. These BG and BS can be purchased either form local BG and BS establishments at competitive prices or from the Outside System at a fixed cost of $130,00 per unit. The BG and BS requirements for normal operation, level one developments, are summarized below.

Land Use	Requirements for Normal Operation: Purchases From:		
	BG	BS	Outside
FL1	400 units	120 units	
SG1	200 units	40 units	
MP1	140 units	35 units	
MF1	300 units	180 units	
NL1	100 units	54 units	
EL1	400 units	246 units	
TE1	200 units	174 units	
FO1	30 units	10 units	
TA1	20 units	10 units	
PA1	100 units	44 units	
CR1	150 units	50 units	
NS1	60 units	23 units	
CI1	(Material requirements vary by job)		
BG1			$83,000* (fixed cost)
BS1			$58,000* (fixed cost)
PG1	.037 unit*	.017 unit*	
PS1	.03 unit*	.01 unit	

* These costs and requirements are per CU of output.

6. Utility Requirements

All economic land uses (except CI) require utilities such as water, gas, electricity and sewerage. These services are provided by the Utility Department, which may be public or private. The amount of utility units consumed and the minimum level of utility service required by the various economic land uses of the first level of development are summarized below.

Land Use	Utility Consumption Requirements (units)	Minimum Level of Utility Service
FL1	50	1
SG1	100	1
MP1	700	7
MF1	100	1
NL1	100	1
EL1	200	2
TE1	200	2
FO1	300	3
TA1	100	1
PA1	300	3
CR1	400	4
NS1	76	1
BG1	112	2
BS1	71	1
PG1	99	1
PS1	77	1
RA1	4	1
RB1	26	1
RC1	117	2

The "typical" price of Utility Service is $10,000 per unit but this price may be changed at the discretion of the Utility Department.

7. Employment Requirements

Employees are essential to the functioning of all non-residential land uses (HI, LI, NS, BG, BS, PG, PS) in City. These employees are hired from the population units (1 population unit = 500 persons) which inhabit the simulated area. The number of workers in a given population unit is related to the population unit's class (high, middle, or low). Socio-economic class also determines the salary range which is paid to a worker. Information summarizing typical salaries and number of workers per population unit is given below:

Class	Number of Workers per Population Unit	Typical Annual Salary Per Worker	Typical Annual Salary Per Population Unit
High	120	$10,000	$1,200,000
Middle	160	5,000	800,000
Low	200	2,500	500,000

Each commercial (BG, BS, PG, PS) and industrial (HI, LI, NS) land use has a different employment requirement which describes the number and socio-economic mix of full-time and part-time employees necessary to produce the maximum amount of output (for industry) or capacity units (for commercial estbalishments).

The optimum mix is summarized on page 26, along with the typical wage bill which is paid if these requirements are met. The part-time requirements, in full-time units, are in parentheses.*

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* Social decision-makers allocate time for part-time employment. 80 time units fulfill one full-time job requirement. For further information, see "Time Allocation", page 47.

OPTIMUM MIX

Land Use	Employment Requirements			Typical Wage Bill
	PH	PM	PL	
FL1	8(0)	8(1)	35(3)	$35,800,000
SG1	14(1)	18(2)	23(2)	46,500,000
MP1	19(1)	18(2)	18(4)	51,000,000
MF1	24(1)	18(2)	17(2)	55,500,000
NL1	21(1)	20(1)	18(2)	53,200,000
EL1	30(1)	18(1)	17(1)	61,400,000
TE1	25(1)	22(1)	15(1)	57,600,000
FO1	15(0)	19(1)	24(1)	46,500,000
TA1	15(0)	10(0)	30(3)	42,500,000
PA1	23(1)	17(0)	20(2)	53,400,000
CR1	24(1)	24(1)	14(1)	57,500,000
NS1	23(1)	9(0)	9(0)	40,500,000
		(Hires by job only)		
BG1	14(1)	7(0)	8(0)	27,600,000
BS1	20(1)	9(0)	9(0)	36,900,000
PG1	8(0)	13(1)	22(2)	32,800,000
PS1	6(0)	11(1)	16(2)	25,800,000

Economic decision-makers do not actually hire and fire employees in City. Each round, the computer assigns population units to work locations by means of the employment process. Essentially, the computer optimizes employment by assigning people to work at places where their net salary is maximized (i.e., base salary minus transportation costs to work). Employers in City include HI, LI, NS, CI, BG, BS, PG, PS in the economic sector and the School Department, Municipal Service Department and Bus and Rapid Rail Departments in the governmental sector. (See Figure A.)

In general, the employment process will assign PH workers to high-income jobs, PM workers to middle-income jobs, and PL workers to low-income jobs. However, if there are shortages of jobs for any of the respective classes, population units may become employed at lower class levels. For example, if there are not enough high-income positions available, PH workers will be the first selected to fill middle-income positions and receive middle-income salaries. There is also a built-in bias for workers to continue to work at previous places of employment.

8. Taxes

All economic decision-makers pay local and federal-state taxes. These taxes are collected automatically by the computer and paid to the local government or the Outside System.

There are two types of local taxes which the Chairman can levy on the economic sector. These include property taxes and sales taxes. Property taxes are applied to all privately-owned land as well as to developments. Sales taxes are applied to all purchases of goods (from BG, PG) and all purchases of services (from BS, PS) by a particular development.* All local tax rates are variable and are set by the Chairman.

The federal-state tax rates are fixed. There are two types of federal/state taxes: business income and sales. These taxes are applied to developments owned by an economic decision-maker. The rates for these taxes are summarized below:

Business Income (State)	5% of (gross income minus salaries, minus goods and service payments, minus maintenance payments, minus state sales tax and local sales tax and minus property tax)
Business Income (Federal)	22% of first $25,000 of (gross income minus salaries, minus goods and services payments, minus maintenance payments, minus state sales tax, minus local sales tax, minus property tax, minus state income tax) plus 48% of rest (minus the same deductions).

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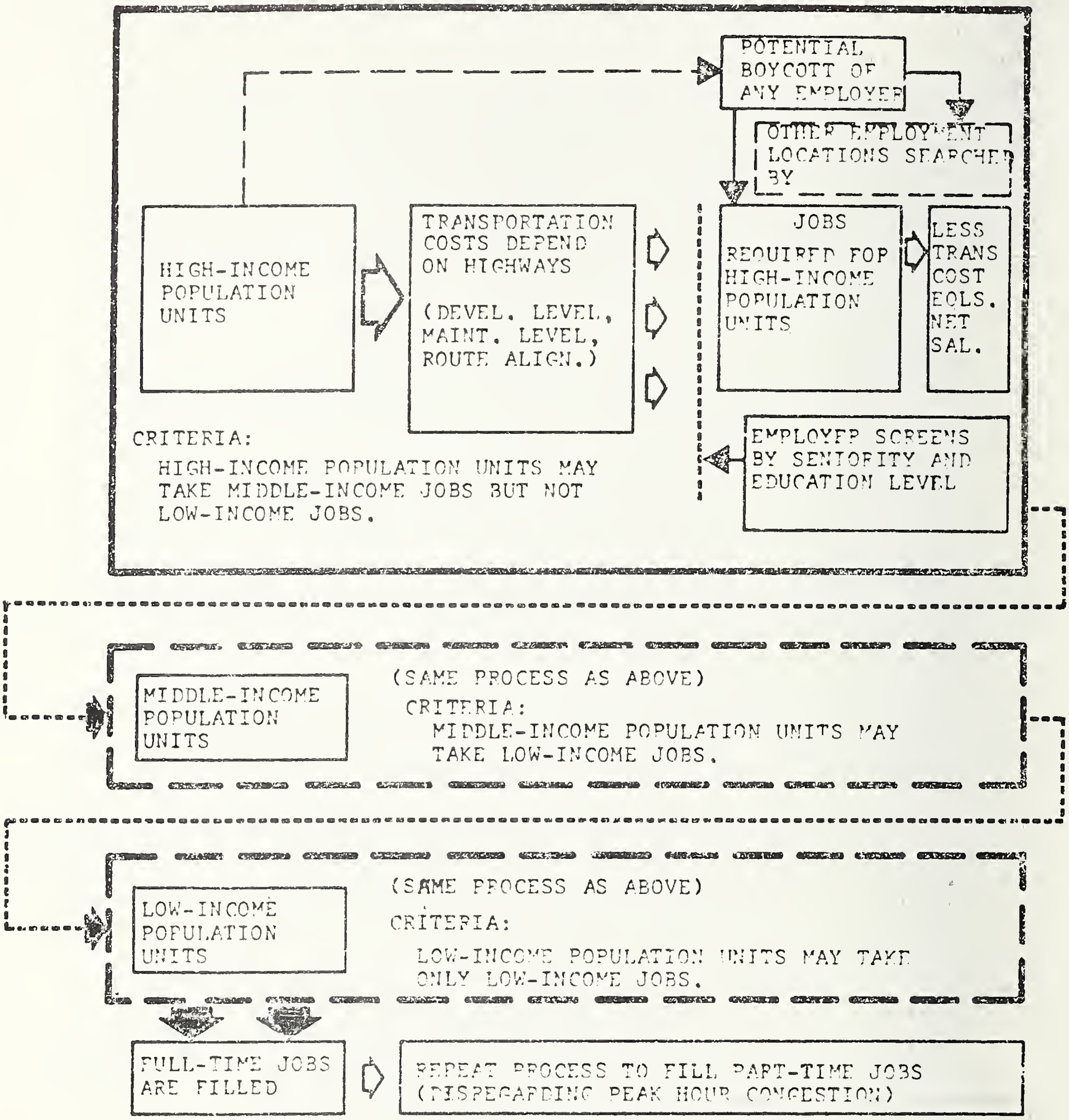
*For further information for determining local tax payments, see page 54, 55.

EMPLOYMENT PROCESS

GOAL: MAXIMIZE NET SALARY, WHICH EQUALS GROSS SALARY MINUS TRANSPORTATION COSTS. A POPULATION UNIT WILL NOT FILL A JOB VACANCY WHERE NET SALARY IS NEGATIVE.



POTENTIAL BOYCOTT OF ANY EMPLOYER
OTHER EMPLOYMENT LOCATIONS SEARCHED BY
HIGH-INCOME POPULATION UNITS
TRANSPORTATION COSTS DEPEND ON HIGHWAYS (DEVEL. LEVEL, MAINT. LEVEL, ROUTE ALIGN.)
JOBS REQUIRED FOR HIGH-INCOME POPULATION UNITS
LESS TRANS COST EQLS. NET SAL.
EMPLOYER SCREENS BY SENIORITY AND EDUCATION LEVEL
CRITERIA: HIGH-INCOME POPULATION UNITS MAY TAKE MIDDLE-INCOME JOBS BUT NOT LOW-INCOME JOBS.
MIDDLE-INCOME POPULATION UNITS
(SAME PROCESS AS ABOVE)
CRITERIA: MIDDLE-INCOME POPULATION UNITS MAY TAKE LOW-INCOME JOBS.
LOW-INCOME POPULATION UNITS
(SAME PROCESS AS ABOVE)
CRITERIA: LOW-INCOME POPULATION UNITS MAY TAKE ONLY LOW-INCOME JOBS.
FULL-TIME JOBS ARE FILLED
REPEAT PROCESS TO FILL PART-TIME JOBS (DISREGARDING PEAK HOUR CONGESTION)

Figure A

Sales Tax (State) — 3% of the total purchases from BG and BS or PG and PS establishments.

9. Capacity

In City Model, all non-residential land uses have design and effective capacities. In the case of basic industry, capacity may be thought of as capacity units (CU's) of output that can be produced and sold to the Outside System. The capacity of a construction industry is determined by its level, the value ratio of its equipment, and the labor actually hired. For commercial establishments capacity may be thought of as units (CU's) of goods and/or services supplied to customers in the local system at prices determined by the owner of a particular establishment. The design capacity for the various economic land use types is summarized below:

Land Use Type	Design Capacity
HI1 *	1000 units
LI1 *	1000 units
NS1	1000 units
CI1	1000 units
BG1	5000 units
BS1	1500 units
PG1	16,000 units
PS1	8000 units

There are two influences in City Model which reduce design capacity to form effective capacity. When an industrial or commercial establishment does not meet its employment requirements, its design capacity is reduced in the following manner:

$$\frac{\text{P1's actually employed}}{\text{P1's required}} \text{ X Design Capacity} = \text{Capacity due to Employment Mix}$$

For example, to produce design capacity (output) an HI1 needs to employ a total of 21 PH's, 30 PM's and 9PL's (including part-time workers). Suppose the computer assigns the necessary number of PH's and PL's, but because a competitive salary is not offered to middle-income workers, it assigns only 6 PM's. In reducing design capacity the computer would perform the following operation:

$$\frac{36}{60} \text{ X } 1000 = 600 \text{ capacity units of output.}$$

---

* HI 1 and LI 1 are here symbolic of the seven HI and four LI land uses in the model.

Value ratio also acts in conjunction with employment mix to determine effective capacity. In this case, capacity due to employment mix is multiplied by VR/100. In other words, if the HI1 in the example above has a VR of 80, its effective capacity would be 480 (600 x 80/100).

In some cases, a BG, BS, PG or PS may sell more capacity units than its effective capacity. In such a case, the demand for goods and services is greater than the supply. If the actual number of units sold by a commercial establishment is greater than its effective capacity, it will depreciate at a faster rate due to overuse.

D. Effects of the Outside System on the Economic Sector

The Outside System should be thought of as the outside influences, primarily economic, on the local system. It is the source of all money which enters the local economy from the outside as well as the destination of all money leaving the local economy. The primary influences of the Outside System on the local economy include the business cycle, federal-state taxes and aid, and migration.

Essentially, the business cycle is the barometer of how the economy outside the local area is faring. Consequently, it indicates the probability of success in economic ventures and investments. In City Model, the business cycle plays an important role in determining the price paid for basic industry (HI, LI, NS) output. The price per unit of output varies directly with the business cycle. During periods of prosperity, prices are higher, and during periods of recession prices are lower. Like all other outside influences, the fluctuations of the business cycle are handled entirely by the computer.

The business cycle also affects the interest rates on loans from the Outside System and rates of return on speculative and conservative investments.

Federal/state taxes are also paid to the Outside System at fixed rates. There are three types of federal/state taxes: Business Income, Personal Income, and Sales. Federal/state aid is available to several government departments for certain current and capital expenses.

The remainder of this section will deal in greater detail with the specific characteristics of the various economic land uses in City Model. These characteristics differ according to the classification of the land use into the following categories: Basic Industry, Construction Industry, Commercial Establishments and Residences.

E. Basic Industry

1. Income

Each of the three types of basic industry in City Model (HI, LI, NS) sells its output to the Outside System. The income to the local systems for these sales is primary input for local economic activity. The maximum output for an HI1, LI1, or NS1 is 1000 units. The average price per unit of output is determined by the Outside System. The average prices per unit of output are $184,000 for HI, $154,000 for LI, and $110,000 for NS.[1] These prices will change somewhat depending on outside economic conditions. The price paid for HI output is the most variable and the prices paid for NS output is the least variable in the business cycle.

2. Expenditures

Expenditures for basic industry are for maintenance and normal operations, utilities, salaries, transportation and taxes. Maintenance and normal operation, utilities and salaries were discussed earlier (see page 12).

Transportation costs are incurred by HI, LI and NS when acquiring goods and services from BG and BS necessary for maintenance and normal operation, and (except for NS) for shipping finished goods to terminals from which they are distributed to the Outside System. These costs vary according to type of road, user, and destination.

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[1] Detail prices for each of the seven HI types and four LI types are given in the Master Table for Industrial Establishments.

TRANSPORTATION COSTS

	Transportation Costs Per Mile-on HY3* per CU			
User	To BG	To BS	To Terminal**	Terminal Units
FL	2500	1500	2500	1000
SG	6000	1500	2000	10000
MP	7000	1500	2000	6000
MF	2700	1500	1500	2000
NL	7000	1500	1000	1000
EL	1000	1500	500	1000
TE	2500	1500	1500	2000
FO	1000	1500	1000	3000
TA	5000	1500	50	1000
PA	2000	1500	1500	3000
CR	2000	1500	1000	3000
NS	1250	NA	NA	NA

---

* A HY3 is the largest road and therefore the least expensive for transportation. Costs are double on a HY2 and triple on a HY1.

** BG and BS and terminal users pay an additional charge that is equal to one mile of travel along a HY3. NA means Not Applicable.

F. Construction Industry

1. Income

a. Prices

A construction industry (CI) earns income by charging prices for the construction, upgrading, and demolition of economic and governmental land uses in the City Model. The prices that A CI charges are not fixed; they depend upon the costs to the CI and the outcome of negotiations between it and a player. The typical prices charged are listed on page 34. These prices assume that typical salaries are paid to CI workers, that the distance to the building site is five miles, that the distance to BG and BS (for purchase of materials) is two miles and that the CI is operating at 80% of capacity. Further, these figures include a rate of return of 22%.

A first approximation of what it would cost the construction company to build a particular land use can be obtained by calculating: the number of workers required and the wages that would have to be paid them, the number of equipment units required, and the purchase from BG and BS of the material needed to build a structure given the specified number of equipment and material units and labor units. For example, an NSI requires 250 units of equipment and material units and labor units. For example, an NS1 requires 250 units of equipment and materials and 250 units of labor. This means it will require five population units of workers from each of the three income classes, yielding a typical wage bill of $12,500,000. Two hundred and fifty material units from business goods and business services would yield approximately $11,000,000 worth of BG purchases and $1,500,000 worth of BS purchases. A construction industry owner could then estimate transportation costs and taxes, mark up this figure for the desired profit, and use the result as an offer price in negotiations with the client.

b. Contracts

Players, both government and economic, negotiate contracts with the construction industry for new construction, upgrading and demolition. The contract is filled by the construction industry with the assistance of the player for construction. Owners of proposed construction sites are responsible for checking on land and zonging requirements, utilities, and money (their cash balance on the computer printout) before submitting the contract. These requirements must be met before the contract is accepted by the computer. The construction contractor is paid in the round when the contract is classified by the computer output as "pending"; the construction industry's employees and BG and BS are also paid at this time. The new building becomes operative after the round of construction time.

The contract will not be accepted by the computer if the above requirements are not met.

TYPICAL PRICES CHARGED

Development	Typical Construction Price Charged*	Typical Demolition Price Charged
Economic Sector		
FL1	$ 300,000,000	$ 60,000,000
SG1	240,000,000	48,000,000
MP1	240,000,000	48,000,000
MF1	320,000,000	64,000,000
NL1	150,000,000	30,000,000
EL1	140,000,000	28,000,000
TE1	180,000,000	36,000,000
FO1	230,000,000	46,000,000
TA1	120,000,000	24,000,000
PA1	250,000,000	50,000,000
CR1	250,000,000	50,000,000
NS1	50,000,000	10,000,000
BG1	25,000,000	5,000,000
BS1	10,000,000	2,000,000
PG1	30,000,000	6,000,000
PS1	10,000,000	2,000,000
CI1	120,000,000**	60,000,000***
RA1	1,000,000	200,000
RB1	6,000,000	1,200,000
RC1	25,000,000	5,000,000
Governmental Sector		
SC1	27,000,000	5,400,000
MS1	30,000,000	6,000,000
HY1	800,000	160,000
TM1	14,000,000	2,800,000

---

* If the construction industry is not being used in a game, all construction prices are "typical".

** The construction cost of a CI is paid to the Outside System. A CI cannot build a CI.

*** The owner of a CI1 receives this amount for equipment sold (i.e., demolition).

2. Expenditures

A CI spends money for employment, equipment and materials, maintenance, transportation and taxes. Maintenance and taxes were discussed earlier (see page 20).

a. Employment

A CI employs equal numbers of workers from population units of each socio-economic class but allocates the workers to construction sites in smaller units. This is because most construction jobs do not require labor in even multiples of the number of workers in a population unit. A particular construction job will require a number of units of labor. One population unit from each of the three classes supplies 50 units of labor. Units of labor required to build depends on type of land use. No labor is required for demolition.

To determine the full-time employment request in each class for a CI, the computer divides by 50 the total number of labor units required to perform all of the CI's contracts. The remainder is half of the part-time employment needed in each class. For example, suppose a CI1 had a contract to build a PG1 (150 labor units) and a BG1 (125 labor units). The full-time employment request is 5 PH, 5 PM, and 5 PL (275 ÷ 50 = 5 and 25/50). The part-time request is 50 times units PH, 50 units PM, and 50 units PL (25 x 2).

b. Equipment and Materials

Construction also requires equipment and materials. Equipment is a capital investment and is purchased from the Outside System in the process of forming a CI. The amount of equipment owned by A CI is a function of its level of development, i.e., a CI1 has 1000 units, a CI2 has 2000 units and a CI3 has 3000 units of equipment.

Materials are purchased either form local BG and BS establishments at competitive "prices" or from the Outside System at fixed costs of $130,000 per unit of BG or BS.

For a CI, one unit of material is the equivalent of .44 BG units and .06 units of BS.

Labor, equipment and material requirements for the various land uses are summarized on page 36.

As for other businesses, a CI's employment and value ratio affect its capacity. The computer accepts contracts requiring a sum of equipment units up to 1000 times the CI's level. Later, after each CI has received its employees, the computer determines the status of each CI's new contracts. The number of equipment units which can be used is value ratio/100 times design capacity. If the number of euqipment units required for new contracts exceeds that amount, the computer will defer contracts, starting with the last accepted, until the number of equipment units required is less than value ratio/100 times design capacity.

EQUIPMENT AND MATERIAL REQUIREMENTS

Land Use	Construction Units of Equipment	Construction Units of Material	Construction Units of Labor	Demolition Units of Equipment	Demolition Units of Material
Economic Sector					
HI	525	525	525	105	359
LI	325	325	325	65	222
NS	250	250	250	50	171
BG	125	125	125	25	86
BS	50	50	50	10	34
PG	150	150	150	30	103
PS	50	50	50	10	34
RA	5*	5*	5*	1	3
RB	30*	30*	30*	6	21
RC	125*	125*	125*	25	86
Governmental Sector					
SC1	135	135	135	27	92
MS1	150	150	150	30	103
HY1	4	4	4	1	3
TM1	70	70	70	14	42

---

*These requirements of equipment, materials and labor are for residential construction at QI= 100. New housing can be built at a lower quality index (as low as QI = 40). Requirements diminish according to the equation: R = 1/200*S(100+X) where S is the units of equipment and material or the units of labor required to build a residence at QI = 100 and R is the units required to build the same type of residence at QI = X.

For example, suppose the computer accepted contracts for a CI1 for an HI1 (525 equipment units) and an LI1 (325 equipment units. The CI has a value of 80. It can therefore handle 800 equipment units of construction. (80/100 * 1000). Since the contracts require 850 equipment units, the last submitted must be deferred.

A CI's capacity for contracts requiring employment (all non-demolition contracts) is value ratio/100 times employees hired/employees requested times design capacity. Only construction contracts are deferred if there is an employment shortage at a CI.

Deferred contracts are the first in the "accepted" list next round and have the least chance of being deferred next round. A CI with deferred contracts can accept fewer new contracts (in terms of equipment units) than a CI with the same level and value ratio but no deferred contracts.

c. Transportation

A CI incurs transportation costs when traveling to BG and BS establishments to purchase material and when going to a building site. Transportation costs are \$220 (to BG) and \$30 (to BS) per mile on HY3, per unit of materials purchased, and to a building site, \$60 per mile on HY3 per unit of equipment. A CI can travel to a building site on a road under construction. Further, a CI can travel on road beds (all parcel boundaries where there is not a developed road) at 4 times the cost to travel on a HY3. When a CI is building a highway, the transportation costs are calculated on the basis of the distance to the nearest intersection at the end of each individual road segment, i.e., each segment is treated separately.*

---

*NOTE: A CI builds a road starting from its northern-most or western-most point.

G. Commercial Establishments

1. Buyers and Sellers

The commercial land uses in City (BG, BS, PG, PS) trade with each other, with other establishments in the economic sector and with the government and social sectors. The buyer-seller relationships with commercial establishments is best summarized in the following tables.

Sellers	Buyers		
	Economic Sector	Governmental Sector	Social Sector
BG	HI, LI, NS, CI, PG, PS	SC, MS	
BS	HI, LI, NS, CI, PG, PS	SC, MS	
PG	RA, RB, RC		PH, PM, PL
PS	RA, RB, RC		PH, PM, PL

Economic and social decision-makers who purchase goods and services from commercial establishments do not make contracts with individual BG, BS, PG and PS establishments. Rather, economic and social customers are assigned to BG, BS, PG, and PS establishments by the Commercial Process. The government departments requiring goods and services for their operation and maintenance, however, do make contracts with individual BG and BS establishments. In effect, government decision-makers must perform the commercial process themselves if they want to acquire goods and services at the least cost. Governments do not pay transportation costs for goods and services.

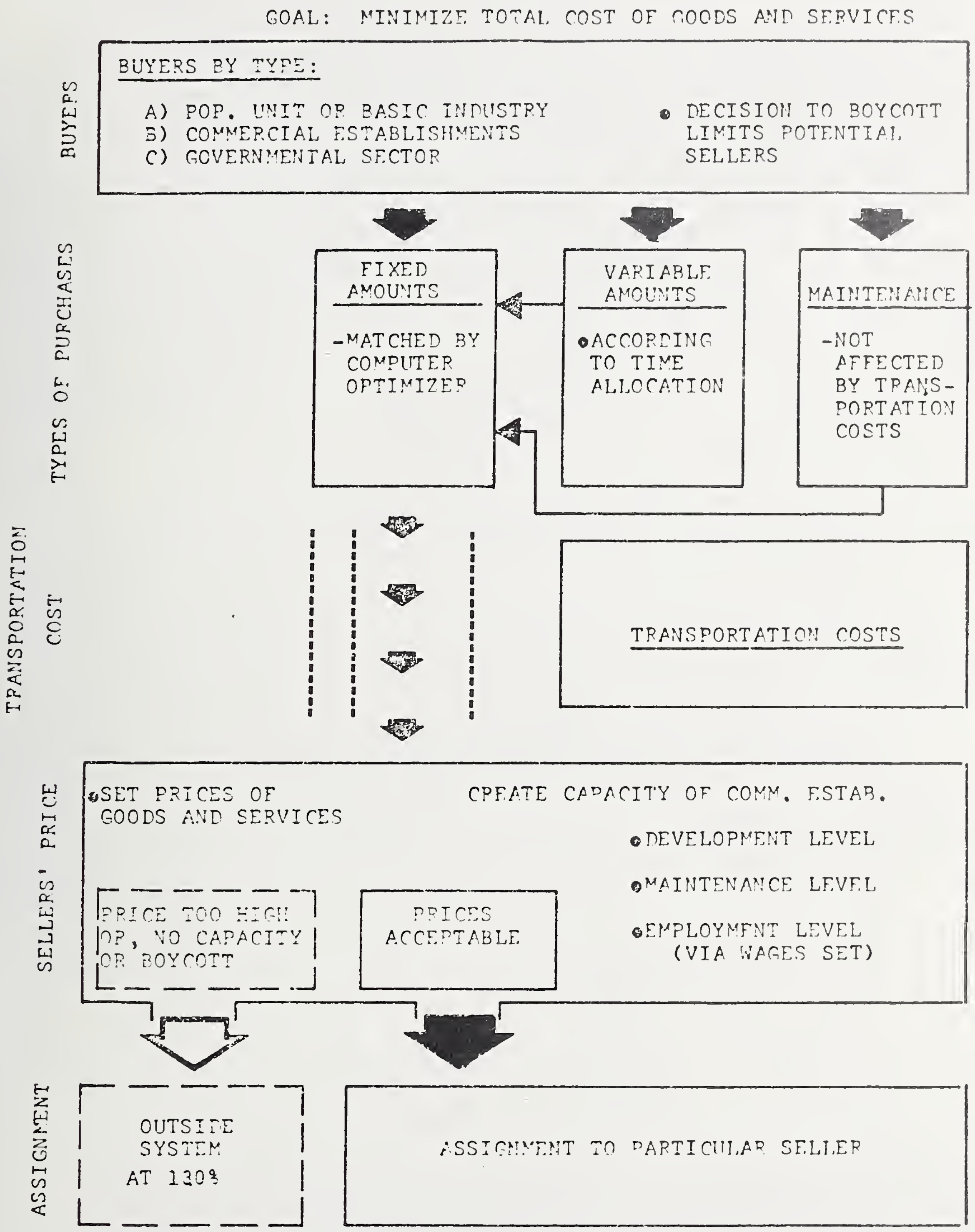
2. The Commercial Process

In the commercial process, economic and social sector purchasers of goods and services are assigned by the computer to commercial establishments on the basis of least total price (i.e., price charged plus transportation costs). In the commercial process there is a built-in bias for buyers to shop at the same establishment as in the previous round. Further, there is also a bias against shopping in overcrowded establishments. (See Figure B.)

3. Boycott

Economic and social decision-makers may boycott commercial establishments. When a boycott occurs, under no circumstances will a boycotting customer buy from the specified commercial establishment.

COMMERCIAL PROCESS


GOAL: MINIMIZE TOTAL COST OF GOODS AND SERVICES
BUYERS
BUYERS BY TYPE:
A) POP. UNIT OR BASIC INDUSTRY
B) COMMERCIAL ESTABLISHMENTS
C) GOVERNMENTAL SECTOR
● DECISION TO BOYCOTT LIMITS POTENTIAL SELLERS
TYPES OF PURCHASES
FIXED AMOUNTS
-MATCHED BY COMPUTER OPTIMIZER
VARIABLE AMOUNTS
●ACCORDING TO TIME ALLOCATION
MAINTENANCE
-NOT AFFECTED BY TRANSPORTATION COSTS
TRANSPORTATION COST
TRANSPORTATION COSTS
SELLERS' PRICE
●SET PRICES OF GOODS AND SERVICES
CREATE CAPACITY OF COMM. ESTAB.
●DEVELOPMENT LEVEL
●MAINTENANCE LEVEL
●EMPLOYMENT LEVEL (VIA WAGES SET)
PRICE TOO HIGH OR, NO CAPACITY OR BOYCOTT
PRICES ACCEPTABLE
ASSIGNMENT
OUTSIDE SYSTEM AT 130%
ASSIGNMENT TO PARTICULAR SELLER

● PLAYER DECISION POINTS

Figure B

4. Income

Commercial establishments earn income from the sale of their goods and services. The amount of goods and services sold depends upon the capacity at which a particular establishment is operating. The maximum capacity (units produced) is 5,000 for a BG1, 1,500 for a BS1, 16,000 for a PG1, and 8,000 for a PS1. The maximum capacity, of course, can be reduced by insufficient employment and by the value ratio of less than 100. Prices charged per capacity unit are determined by the owner of the individual establishments. Capacity and typical prices are summarized:

Land Use	Maximum Capacity (Units)	Typical Price/Unit*
BG1	5,000	$100,000
BS1	1,500	100,000
PG1	16,000	10,000
PS1	8,000	10,000

5. Expenditures

Commercial establishments, like industrial land uses, spend money for maintenance and normal operation, utilities, employment and taxes. These expenditures were discussed earlier (See page 20).

In addition, all businesses except BS incur transportation costs. BG incurs costs for receiving goods from the Outside System at a terminal and PG and PS incur costs for purchasing goods and services from within the system. These costs are:

Transportation Costs per Capacity Unit of Output
Per Mile Along HY3**

Land Use	To Terminal	To BG	To BS
BG1	$400	--	--
BS1	--	--	--
PG1	--	$17	$8
PS1	--	15	5

---

* An owner may charge above or below this figure, but he must remember that a buyer can purchase BG, BS, PG and PS units from the Outside System at $130,000 per unit of BG and BS or $13,000 per unit of PG and PS with no transportation costs to the purchaser.

** A HY3 is the largest road and, therefore, the least expensive to travel on. Costs are double on HY2 and triple on HY1. A journey of one mile on an HY3 is added to the actual distance traveled.

H. Residences

1. Income

Economic decision-makers own 3 types of residences (RA, RB, RC) in the City Model. Like owners of commercial establishments, owners of residences earn income by charging prices (i.e., rents). The number of population units which can live in a given residence depends on its type and its level of development. The quality index for residences indicates the physical conditions of the housing; the higher the QI (0-100), the better the conditions. Further, the QI and the amount of overcrowding will determine whether or not a particular socio-economic class will move into a given residence. The Table below summarizes the number of occupants which the 3 types of residences (level 1) can accommodate in addition to indicating the minimum QI requirements for each socio-economic class:

Population Class	Design Capacity Population Units (Occupants per Housing Unit)			Minimum QI
	RA1	RB1	RC1	
High (PH)	1	6	25	70
Middle (PM)	1.5	9	37.5	40
Low (PL)	2	12	50	20

Owners of residences specify rents on the basis of the rent which they would charge low-income population units. Middle-income rentors pay 1.33 times as much and high-income rentors pay 2 times as much. The principal criteria for determining rents is the quality index. An economic decision-maker cannot expect people to live in his housing with a QI of 50 when they can find housing with a QI of 85 and comparable other features. (See "Migration," in Chapter V: The Social Sector.) The typical rents that can be charged to tenants of each class are summarized below.

Residential Type	Typical Rents		
	PH	PM	PL
RA	$330,000	$200,000	$140,000
RB	330,000	200,000	140,000
RC	330,000	200,000	140,000

The maximum rent which can be charged is $210,000 per PL1.

Total income from operating a residence is, therefore, determined by multiplying the number of occupants from each class times the rent charged to each class. For example, suppose economic decision-maker B owns an RA2 with 6 PH's and 9 PM's living there. He charges a rent of $160,000 per PL. His income from that residence is $3,835,200 (($160,000 x 1.33 x 9) + ($160,000 x 2 x 6)). Typical income, assuming that the unit is occupied at design capacity by one class and typical rents are charged, is below:

Residential Type	Income from Typical Rent		
	PH	PM	PL
RA	$ 330,000	$ 300,000	$ 280,000
RB	1,980,000	1,800,000	1,680,000
RC	8,250,000	7,500,000	7,000,000

2. Expenditures

Owners of residences spend money chiefly for maintenance, utilities and taxes. These expenditures were discussed earlier (see page 20).

I. Economic Sector Decisions

An economic decision-maker in City can make any or all of the following decisions during a round of play: invest in or sell stocks; borrow and lend money; bid on or purchase land; change rents, prices, salaries, and maintenance levels; transfer cash; boycott; construct and demolish developments.

1. Bid on and/or Purchase Land or Developments ($PU)

An economic decision-maker may purchase land from either of two sources: another player or the computer. When purchasing land from another player, the terms of the purchase are settled upon by mutual agreement. When purchasing a parcel of land, an economic decision-maker must purchase all of the parcel that is not owned by the government or in preempt uses.

A participant in the economic sector may also purchase land from outside interests represented by the computer. When bidding on outside land, one must determine the fair market value. It is suggested that one use the volumes shown on the Auction Asking Price Map to determine the value of computer-owned parcels. Each round the computer selects some outside-owned land to be auctioned. The Auction Asking Price Map shows these parcels. Other outside-owned land may also be bid for, but the chances of acceptance are much less. Factors to consider when bidding on land are proximity to other developments, access by roads, zoning and availability of utilities. There is a charge of 2% of the bid price on any bid on land owned by the computer, regardless of the bid's success or failure.

2. Change Rents, Prices, Salaries, and Maintenance Levels ($CVPT)

Owners of all residences may specify the rents which they charge to their tenants. In City rents are specified in terms of the rent charged to one low-income (PL) population unit in thousands of dollars (Rent/PL1/$1000).

Owners of BG, BS, PG, PS can set the price paid for one capacity unit (CU) of goods and/or services produced. When setting prices, an economic decision-maker must realize that customers can boycott BG, BS, PG and PS establishment or go to the Outside System and purchase goods and services at $130,000 per unit (BG, BS) and $13,000 per unit (PG, PS).

Owners of HI, LI, NS, BG, BS, PG, PS, and CI all employ workers. They set the salary which they pay their workers at each establishment which they own. Typical salaries per worker and per population unit of the socio-economic classes are summarized below:

Class	Number of Workers per P1	Typical Salary Per Worker	Typical Salary Per P1
High (PH)	120	$10,000	$1,200,000
Middle (PM)	160	5,000	800,000
Low (PL)	200	2,500	500,000

Finally, economic decision-makers can also set the maintenance level of their buildings. The maintenance level indicates the minimum value ratio at which a particular land use is to be maintained. In effect, this allows a decision-maker to counteract the effects of depreciation (i.e., a declining value ratio). Owners of residences can not raise the maintenance level of an RA, RB, or RC more than 20 points above the lowest value ratio which the building has ever had.

In renovating or maintaining a land use, it is necessary to purchase goods and services from either within the local system or from the Outside System. The requirements of goods and services for maintainence and renovation were given earlier (see page 21).

3. Transfer Case ($CASH)

Economic and social customers are assigned to BG, BS, PG, and PS locations by the commercial process. In this process, the computer assigns customers on the basis of least total cost (i.e., prices charged plus transportation costs). Further, there is a built-in bias for buyers to shop at the same establishments as in the previous round. Economic decision-makers, however, can boycott commercial establishment from which they buy goods and/or services for normal operation of their buildings and/or maintenance. In doing this, they specify which of their developments will not purchase goods and/or services from certain PG, PS, BG, and BS establishments in the city. A boycott remains in effect until it is stopped. If a boycott occurs, the customers will be assigned to other shop locations or to the Outside System at fixed costs of $130,000 per unit of BG or BS and $13,000 per unit or PG or PS.

4. Lend, Borrow, and Invest ($OTHER)

An economic decision-maker may lend money to or borrow money from another decision-maker. In such a case, the interest rate is set by mutual agreement but the term of the loan must be either 2 or 25 years. An economic decision-maker may also borrow money from the Outside System (OU). When doing such, the term of the loan is specified by the borrower but the interest rate is set by the Outside System (i.e., the computer). No economic decision-maker may have more than 80% of his total assets in outstanding principal for loans in the Outside System at one time.

Economic decision-makers may also invest in conservative or speculative stocks. The returns of these investments are determined by the Outside System and range from -1% to 10% for speculative investments and from 5% to 7% for conservative investments.

5. Build, Upgrade, or Demolish Developments ($BUILD or $OUBLD)

Economic decision-makers may build new developments or upgrade (i.e., add an additional level of development) or demolish existing ones. In the City Model all construction can be accomplished either through contracts with a local construction industry or by the Outside System at 1.3 times the typical construction costs. Demolition costs by the Outside System are one-fifth of the Outside System construction costs. The typical construction costs for local firms are summarized on the table appearing on page 45.

TYPICAL CONSTRUCTION COSTS - LOCAL FIRMS

Land Use Type	Construction Costs	Typical Demolition Costs
FL1	$ 300,000,000	$ 60,000,000
SG1	240,000,000	48,000,000
MP1	240,000,000	48,000,000
MF1	320,000,000	64,000,000
NL1	150,000,000	30,000,000
EL1	140,000,000	28,000,000
TE1	180,000,000	36,000,000
FD1	230,000,000	46,000,000
TA1	120,000,000	24,000,000
PA1	250,000,000	50,000,000
CR1	250,000,000	50,000,000
NS1	50,000,000	10,000,000
CI1	120,000,000	60,000,000*
BG1	25,000,000	5,000,000
BS1	10,000,000	2,000,000
PG1	30,000,000	6,000,000
PS1	10,000,000	2,000,000
RA1	1,000,000**	280,000**
RB1	6,000,000**	1,200,000**
RC1	25,000,000**	5,000,000**

Value Ratio	Typical Construction Costs		
	RA	RB	RC
40	$ 700,000	$ 4,200,000	$ 17,500,000
50	750,000	4,500,000	18,750,000
60	800,000	4,800,000	20,000,000
70	850,000	5,100,000	21,250,000
80	900,000	5,400,000	22,500,000
90	950,000	5,700,000	23,750,000

---

[*] The owner of a CI1 receives this amount for equipment sold (i.e., demolition).

[**] These figures are for building residences when value ratio = 100. For building residences at other value ratios, see the table below.

When building or upgrading developments, players should check to see that the proper level of utility service is installed at the construction site. In no case will construction be completed when there are insufficient utility units provided. The utility requirements for economic land uses are:

Land Use Type	Utility Units Required	Minimum Level of Utility Service
FL1	50	1
SG1	100	1
MP1	700	7
MF1	100	1
NL1	100	1
EL1	200	2
TE1	200	2
FO1	300	3
TA1	100	1
PA1	300	3
CR1	400	4
NS1	76	1
BG1	112	2
BS1	71	1
PG1	99	1
PS1	77	1
RA1	4	1
RB1	26	1
RC1	117	2

Proposed construction will also be rejected unless it conforms to zoning codes established by the Planning and Zoning Department. These codes are:

Any Use	00
Any Business	10
Any Manufacturing	20
HI*	21
LI*	22
CI	23

* HI and LI are symbolic of the eleven sub categories of industrial land use.

Any Non-Manufacturing	30
NS	31
BG	32
BS	33
PG	34
PS	35
Any Residential	40
RA	41
RB	42
RC	43
Parkland	50

In the City Model, there can be only one type of economic land use on a parcel. Furthermore, if accepted, all construction is completed one full round after the contract is submitted to the computer, unless the CI does not acquire sufficient labor. If a CI has a labor shortage, some contracts are deferred until the next round. Note that if the construction is to be done by the outside system and there is no CI in the city, then the construction is completed in the round after the decision to construct is submitted.

IV. THE SOCIAL SECTOR

Social decision-makers in City Model (identified) as AA, BB, CC, etc.) represent people who live and work in the simulated area. These people perform several different activities: they vote, they boycott, they save and spend money, and they allocate time to such activities as extra education, part-time employment, politics, and recreation. These activities are the chief assets of the social decision-maker. With these assets, he can exert a powerful social voice in the community and subsequently influence the decision-making process in the economic and government sectors of the City Model.

A. Population

People in the City Model are divided into population units (P1's) of 500 persons each. In addition, population units are divided into three socio-economic classes: High (PH), Middle (PM), and Low (PL). Population units share certain characteristics, which are summarized below:

Class	Number of Workers	Number of Students	Normal Registered Voters
PH	120	130	200
PM	160	140	140
PL	200	100	100

1. Income

Population units in the City Model can earn income by working full or part-time for employers in either the economic (HI, LI, NS, CI, BG, BS, PG, PS) or government (SC*, MS, BUS, RAIL) sectors. The typical salaries for full-time employment are $10,000 per PH worker, $5,000 per PM worker, and $2,500 per PL worker. These salaries are set by individual employers (i.e., economic and governmental decision-makers).

Unemployed population units can earn income from welfare payments which are determined by the chairman.

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[*] NOTE: Only the School Department hires part-time workers in the government sector.

2. Expenditures

Each round, population units spend money for certain required items: personal goods (PG) and personal services (PS); rent; transportation (to PG and PS establishments and to work); private adult education (if time is allocated); private education (if sufficient public education is not supplied by the School Department); recreation (if time is allocated); and taxes. These requirements are summarized below:

	PH	PM	PL
PG Requirements	34 units	28 units	21 units
PS Requirements	16 units	11 units	7 units

(NOTE: Population units can purchase goods and services from local PG and PS establishments at competitive prices (the typical price is $10,000 per unit of PG or PS) or from the Outside System (if a boycott of a PG or PS is in effect or if local supply is insufficient) at a fixed price of $13,000 per unit.)

	PH	PM	PL
Typical Rent	$330,000	$200,000	$140,000

(NOTE: Rents are set by individual landlords, i.e., economic decision-makers who own residences. Actual rents may vary above or below these typical figures.)

To Work*		PH	PM	PL
	Base:	$210/worker	$190/worker	$140/worker
Plus	HY1:	60/worker/mi	55/worker/mi	50/worker/mi
	HY2:	50/worker/mi	45/worker/mi	40/worker/mi
	HY3:	40/worker/mi	35/worker/mi	30/worker/mi
To PG	Base:	$50 per unit	$50 per unit	$50 per unit
	HY3:	50/unit/mi	50/unit/mi	50/unit/mi
To PS	Base:	$50 per unit	$50 per unit	$50 per unit
	HY3:	50/unit/mi	50/unit/mi	50/unit/mi

(NOTE: There are three types of highways in City Model: HY1, HY2, and HY3. An HY3 is the largest highway and, therefore, the least expensive to travel.)

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*Costs are for uncongested roads. If a road is overcrowded by 20%, it will take a P1 20% longer to travel on it and cost 20% more than the normal cost.

Transportation Charges by Bus
- Rates are set by the Bus Company -

Transportation Charges by Rail
- Rates are set by the Rail Company -

Private Adult Education (cost per time unit)	PH	PM	PL
	$3,000	$3,000	$3,000

Recreation
(consumption units per time unit)

PG	.1	.05	.025
PS	.075	.05	.0

(NOTE: These costs for adult education and recreation are fixed per unit of time that is allocated. Cost for recreation involve purchase of PG and PS and are added to normal expenditures for PG and PS.)

Private Education per P1 (children)
(if sufficient public education is not supplied)

	$37,500	$25,000	$12,000

Taxes	PH	PM	PL
Local			
Income			
Sales	Local tax rates are set by Chairman		
Automobile			
Federal-State			
Income	12% (of wages)	6% (of wages)	3% (of wages)
Sales	3% of total purchase of PG and PS		

B. Dissatisfaction

The people in the simulated area will react to any decisions which affect them. The computer calculates the amount of dissatisfaction which a population unit experiences. Dissatisfaction is measured in terms of a population unit's dissatisfaction with its residence (housing dissatisfaction) and its personal situation in the community. Housing dissatisfaction is determined by quality index, school quality, municipal service quality, taxes, and rent. Personal dissatisfaction is determined by the employment status of the population units involved, in addition to the amount of time which they are not able to spend in an activity which it was allocated for (i.e., involuntary time). Those population units who have the highest dissatisfaction index will be the most likely to migrate.

C. Migration

Migration is a phenomenon inherent to all urban areas. People are continually moving within, into or out of a city. In City Model population units may migrate in three ways: internally, out of the system, and into the system. Migration is calculated by the computer based upon local conditions reflecting the actions of the players.

The computer will pick a certain percentage of the local population units with the highest total dissatisfaction indexes and select these population units to migrate. In addition, the computer will randomly select 7% of the High, 5% of the Middle, and 1% of the Low income population units from the local system to move, regardless of their dissatisfaction indexes.

1. Internal Migration

Each of these population units which has been chosen to migrate looks for vacant housing within the city with a lower housing dissatisfaction index than the housing vacated. If the population unit can find one or several residences with a lower housing dissatisfaction index, it moves into the residence which has the lowest housing dissatisfaction index.

2. Out-Migration

In each round there will be certain number of migrating population units unable to find better housing. This group generally comes from the population units selected at random by the computer form the city's population as a whole. Population units which are unable to find better housing will out-migrate, leaving the city for the outside system.

3. In-Migration

In each round population units move into the simulated urban system. These people are called in-migrants. The total number of in-migrants will average 5% of the total local population plus or minus the effect of the attractive or repulsive qualities of the system as a whole. The computer moves people into the system on the basis of the attractiveness of the area as measured by the relative salary, available housing, job opening, overall school and municipal services conditions and tax rates.

Migration is a real factor in any city. If people can afford it, they are apt to move away from poorly maintained housing in bad neighborhoods which may be tying them to second-rate jobs. By the same token, there is a certain percentage of any population which will grow tired of a particular location and leave for no apparent reason. There will also be poeple from other areas who have found jobs in the city who will move into the system. These are the migratory patterns that City Model takes into account.

The players can exercise only indirect control over migration by minimizing the causes of dissatisfaction and increasing the attractive features of the city as a whole or particular neighborhoods. A player must always remember that migration is mostly a response to player decisions in all sectors.

D. Types of Decisions

There are various types of decisions which a social decision-maker can make for the population units which he represents. These decisions include voting, boycotting, allocating time, and setting the dollar value of time spent traveling to and from work.

1. Voting ($VOTE)

Social decision-makers vote on behalf of those population units they represent in a particular jurisdiction. All elections of Chairman and Councilmen or opinion polls or measurement of government performance are decided by a popular majority.

The number of votes which can be cast by a social decision-maker is determined by the number of registered voters which he controls. When voting by computer, there is a random probability factor which determines how many of those voters will go to the polls.

In terms of determining the course of action in the city, voting is an important instrument. Politicians, if they expect to be elected, must have the support of a number of social decision-makers representing at least a popular majority. Support can be gained in many ways. Candidates can be bound to certain principles and programs before a social decision-maker will throw his votes behind a candidate. This represents the political process in the City Model with all the coalitions, factions, and political trade-offs also found in a real city.

2. Boycotting ($BYCT)

The boycott or strike is the second tool which a social decision-maker has at his disposal. A social decision-maker can direct the population units of any class under his control to strike a place of work (HI, LI, NS, CI, BG, BS, PG, PS, MS, SC, RAIL, and BUS) and/or boycott the places where they shop (PG, PS), and/or boycott a mode of public transportation (BUS and RAIL).

If a social decision-maker boycotts or strikes a particular work or shop location, the computer, through the commercial and employment processes will not assign those population units to work or shop at the specified parcel. Social decision-makers can increase the effectiveness of their boycott or strike by combining their boycotts. In such a manner, pressure groups can have a significant effect on the decisions and actions of employers and commercial establishments.

3. Time Allocation ($TIME)

Social decision-makers are able to allocate the leisure time for population units in each jurisdiction of the simulated metropolitan area. There are no hours or minutes in City Model. Rather, time is stimulated in terms of units. There are 100 units of leisure time available to workers in each population unit. However, this leisure time is decreased by the amount of time which it takes workers to travel to and from their place of employment. Therefore, the actual amount of time which can be allocated by social decision-makers is 100 units minus time spent traveling to and from work.

The number of time units consumed in traveling to and from work varies according to road types, transportation modes, and congestion, and distance traveled. The table below shows the amount of time units consumed according to various modes of transportation (on uncongested roads).

Time Consumption for Travel to and from Work

	On HY1	On HY2	On HY3	Waiting
Automobile (units/mi.)	3	2	1	0
Bus (units/mi.)	4	3	2	1
	Rail	Rail	Rail	Waiting
Rapid Rail (units/mi.)	1	1	1	1

Walk (a journey to work at an adjoining parcel) requires 1 time unit.

Highway congestion affects travel by automobile to work only. The degree to which congestion increases the time spent traveling to work is in direct proportion to the amount of congestion which occurs. For example, if a road is overcrowded by 20%, it will take a P1 20% longer to travel on it.*

Leisure time is further reduced if a population unit lives on a parcel having a high health index, which is a function of the pollution index, residential over-crowding and the use index of the municipal service plant serving the parcel. The rest of leisure time is called allocatable time and it could be spent on extra part-time work, adult education, political activity and recreation.

a. Extra Work

Extra work is part-time work. Social decision-makers specify time units for workers to spend in extra work. Extra employment is offered in two areas: teachers in adult education and certain part-time positions offered by other employers in the economic sectors. A full-time job is equivalent to 80 time units. Therefore, a half-time

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*Bus congestion (in terms of the number of P1's on the bus when it arrives at an intersection where a P1 is waiting) affects a P1's waiting time in direct proportion to the amount of overcrowding.

MIGRATION CYCLE

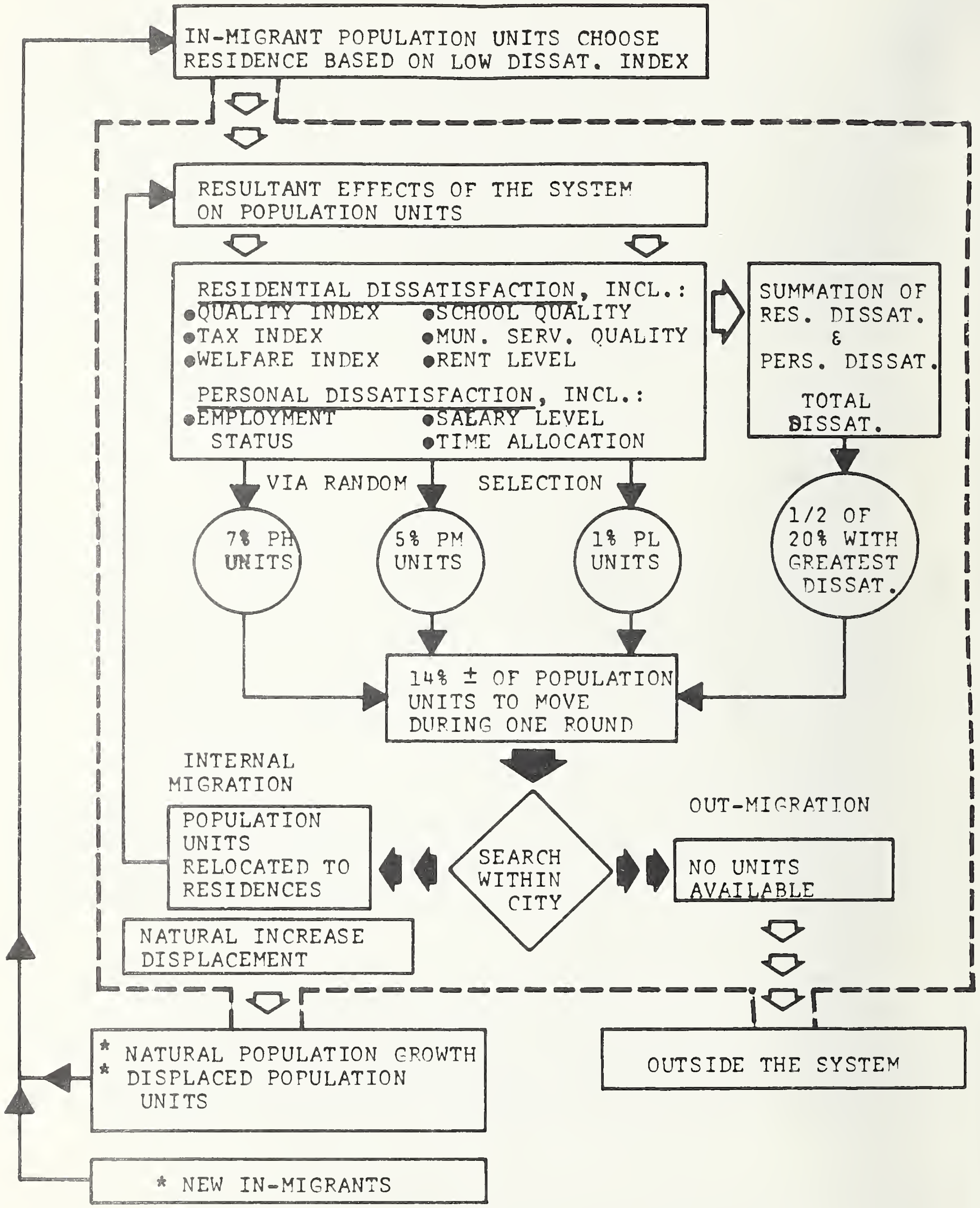
IN-MIGRANT POPULATION UNITS CHOOSE RESIDENCE BASED ON LOW DISSAT. INDEX
RESULTANT EFFECTS OF THE SYSTEM ON POPULATION UNITS
RESIDENTIAL DISSATISFACTION, INCL.:
●QUALITY INDEX
●TAX INDEX
●WELFARE INDEX
●SCHOOL QUALITY
●MUN. SERV. QUALITY
●RENT LEVEL
PERSONAL DISSATISFACTION, INCL.:
●EMPLOYMENT STATUS
●SALARY LEVEL
●TIME ALLOCATION
SUMMATION OF RES. DISSAT. & PERS. DISSAT.
TOTAL DISSAT.
VIA RANDOM SELECTION
7% PH UNITS
5% PM UNITS
1% PL UNITS
1/2 OF 20% WITH GREATEST DISSAT.
14% ± OF POPULATION UNITS TO MOVE DURING ONE ROUND
INTERNAL MIGRATION
POPULATION UNITS RELOCATED TO RESIDENCES
SEARCH WITHIN CITY
OUT-MIGRATION
NO UNITS AVAILABLE
NATURAL INCREASE DISPLACEMENT
* NATURAL POPULATION GROWTH
* DISPLACED POPULATION UNITS
OUTSIDE THE SYSTEM
* NEW IN-MIGRANTS

Figure C

job is equivalent to 40 time units. Workers are paid in proportion to the percentage of a full-time job they fill. If they fill half of a full-time job, they are paid half the salary of a full-time worker in the particular income class. The salary per time unit in extra work is determined by dividing the typical salary of a population unit by 80 time units (the equivalent of a full-time job).

For example, suppose you have allocated 30 units of time to a PH for extra work. The typical salary for a PH is 1.2 million. The salary per time unit in extra work ($1.2m/80) is therefore $15,000. Finally, the total salary earned for that PH for working 30 time units extra is $450,000 (30 x $15,000). This information is summarized in the following table.

Time Allocation - Part-time Employment

	PH	PM	PL
Units of time for full-time job	80	80	80
Typical salary per time unit*	$15,000	$10,000	$6,450

When allocating time to part-time employment, social decision-makers should make sure that such employment is available. If it is not, the time which would have been spent in part-time jobs will become involuntary time. Involuntary time contributes to personal dissatisfaction.

b. Education

Social sector decision-makers may also allocate time to be spent in education. In City Model each population unit has an educational level. The range of an educational level for a population unit is determined by its socio-economic class.

Educational Level

	PH	PM	PL
Minimum	70	40	0
Maximum	99	69	39

Since the educational level of a population unit will affect the ability of that unit to become employed in better jobs, it is the option of social decision-makers whether or not to attempt to maintain educational levels at their present value, increase them, or let them decrease each round by a factor of 10% of the difference between the current level and the minimum level for the population unit of that class. In order to compensate for this decrease in educational level and maintain a maximum level, a population unit should spend time in adult education each round.

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*Typical salary per time unit = $\frac{\text{Typical Salary to Pl}}{80}$

The amount of time which must be allocated to maintain a certain education level is summarized below:

Education Level	Number of Time Units Required to Maintain Education Level		
	PH	PM	PL
0	-	-	0
10	-	-	7
20	-	-	13
30	-	-	20
39	-	-	$\boxed{27}$
50	-	7	-
60	-	13	-
69	-	$\boxed{20}$	-
80	9	-	-
90	18	-	-
99	$\boxed{26}$	-	-

There are two types of adult education in City Model, public and private. Adult education can be obtained for free only if the government sector supplies it. In a situation when time is allocated for free education and there is not enough available, the computer will total the demand with the supply and allocate time units equally on the basis of the demand-supply ratio. Social decision-makers may not allocate time in free education to high income population units. The characteristics of time allocation for adult education are summarized below.

Time Allocation	Adult Education		
	PL	PM	PH
Educational Range	0-39	40-69	70-99
Annual time units required to Maintain Maximum Education Level	27	20	26
Cost per unit (private) per Pl	$3,000	$3,000	$3,000

When allocating time to public adult education, social decision-makers should make sure that the School Department is supplying it. If not, the time which would have been spent in education will become involuntary time. Involuntary time contributes to personal dissatisfaction.

c. Politics

Workers can also spend up to 60 units of leisure time in politics. Time spent in politics will increase the political power of a population unit by increasing its voter registration in a given round. The relationship between time spent in politics and increased voter registration is described below.

	PH	PM	PL
Units of time for 7% increase* in voters registered	10	10	10
Units of time for 10% increase in voters registered	50	50	50
Units of time for 15% increase in voters registered	60	60	60

d. Recreation

Leisure time can also be spent in recreation. Population units who spend time in recreation must buy from PG and PS. The units of PG and PS required per time unit in recreation are given below:

Time Allocation	Recreation		
	PH	PM	PL
Units of PG per unit of time in recreation	.1	.05	.025
Units of PS per unit of time in recreation	.075	.05	0

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*Refers to increase above normal voter registration per income class of population units. Any increase is for one round only.

The most important thing to remember about time allocation is that it is a kind of debit-credit operation. You start with 100 units of time to assign for population units of each class for each jurisdiction. You may estimate that 15 units of time are going to be consumed in traveling to and from work for your PL units; you have only 85 units of time left. In studying the computer output for your PL units, you may discover that they are not receiving enough income, so you allocate 40 units to extra work. Further, the educational level of these PL's is extremely low, so you allocate 25 units for adult education. You now have only 20 units left for politics and recreation. Suppose you split them evenly between these two activities. You then may discover that you guessed wrong when estimating time consumed in traveling to and from work. Because of congestion and an inefficient Highway Department, it takes 30 units of time rather than 15. You allocated 15 units of time too few for travel to and from work and 15 units too many for other activities. Since these are arranged in order of priority, the computer will require these 15 units for transportation from recreation first and then politics. Your PL units will end up spending no time in recreation and only 5 units of time in politics. The result will be that the high-income classes will have a higher rate of registration and hence a greater political voice.

These are just some of the problems with which you will be faced. Remember that you are controlling people represented in units of 500 persons each. Time allocation is a powerful instrument that can greatly affect the balance of social problems and hence the eoncomic and governmental decisions within the simulated city.

4. Setting the Dollar Value of Time ($VALUE)

The computer assigns all population units to modes of transportation to and from work on the basis of least cost. Least cost includes transportation charges per mile (which differ according to mode of transportation, type of road and amount of congestion) as well as the dollar value of time spent traveling. The social decision-maker is able to indicate the dollar value of one time unit consumed traveling to and from work for each of the classes which he represents. The typical dollar values of a time unit spent traveling to and from work are $25 (PL), $50 (PM), $100 (PH).* As the dollar value of a time unit spent traveling increases, the chances are that the computer will assign a more expensive but quicker mode of transportation to work (i.e., via automobile in almost all cases). The following example will demonstrate how the computer considers the dollar value of time.

Let us say the transportation costs for one worker is $150 per year to get to work by bus and $230 to get to work by auto. It also requires an extra 4 time units to travel by bus instead of auto.

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*These values assume typical salaries of $2,500 per PL worker, $5,000 per PM worker, and $10,000 per PH worker.

If the dollar value of time for that population unit was set at $40 (dollar value) or $310 to get to work by bus. To take auto it costs $320 (no extra time units consumed). Therefore, the computer would assign the population unit the BUS mode to travel to work (i.e., $310 is less than $320).

In the same case, suppose the dollar value of time was set to $50. Then the total bus cost would be $150 plus 4 time units times $50 (dollar value) or $350. Auto would cost only $320. Therefore, the computer would assign these population units the auto mode to work (i.e., $320 is less than $350).

V. THE GOVERNMENT SECTOR

Players in the Government Sector of City Model are the public officials of the simulated city. They make public officials of the simulated city. They make public policy, provide public services and raise and disperse funds. Essentially, the Government Sector consists of two components: the elected officials from each jurisdiction (Chairman and Councilmen) and the appointed officials who represent the bureaucracy. The bureaucracy includes at least five departments: Assessment, Schools, Municipal Services, Highway, and Planning and Zoning. It may also include a Utility Department, a Bus Company and a Railroad Company, though these operations can be privately owned and operated.

A. The Chairman and Council (CH)

There is one Chairman and at least one Councilman from each political jurisdiction in City are elected at the beginning of each round by the social decision-makers who cast votes for the population units which they represent. The Chairman and Councilmen have control over the following aspects of governmental decision-making: appointments, budgets, taxes, subsidies and welfare. The extent to which they share this power is an option which is open to the players themselves. Whether they want to govern informally, or formally, accept bribes or extort with government funds is subject to their own judgment. They must remember, however, that they are responsible to the people and that their behavior will be judged at the next election.

The Chairman and Councilmen must appoint players to serve as decision-makers in the bureaucratic departments. These appointments may be made on the basis of any criteria. Nevertheless, it must be noted that the representatives of each department will be responsible to the Chairman and Councilmen. The greater extent to which these departments are willing to cooperate with the elected representatives of the people, the greater are the chances that they will get the funds they need to operate their departments and therefore provide quality services to the public.

B. Chairman Decisions

The Chairman of the city can make any or all of the following decisions during a given round: appropriate funds, distribute subsidies, change tax rates, set welfare payments, and float bonds. The Chairman has a current account only; all tax revenues and expenditures are through that account. Any unspent department funds remain in the department's treasury; they do not revert to the Chairman's account.

1. Appropriate Funds ($CASH)

The Chairman and Council in every jurisdiction are responsible for formulating the budget for the operation of the government departments. Basically, the budgetary process involves the allocation of appropriations to the various departments. Departments which receive appropriations are: Schools, Municipal Services, Highways, and Planning and Zoning. The Utility Department, Bus and Rail Companies receive income from user charges and fares; therefore, they do not receive direct appropriations. There is no formal manner in which players representing the various departments are expected to file appropriations requests with the Chairman.

The Chairman must be sure to indicate whether he is appropriating money to the capital or current account of a given department or both. For example, when appropriating money for purpose of constructing new facilities or purchasing land, that money must go to a capital account. On the other hand, funds for the normal operation or maintenance of a department should be appropriated to the current account of that department. All appropriations will automatically continue at previous rates unless an input change is issued in subsequent rounds.

2. Distribute Subsidies ($CASH)

Subsidies may be given to the Utility Department, the Bus Company, the Rail Company, or to any economic decision-maker. It is only necessary to specify the account (capital or current) to which the money is being subsidized. A subsidy is granted for one round only, unlike an appropriation.

3. Transfer Case ($CASH)

The Chairman may transfer cash to any government department or to an economic decision-maker. A cash transfer shows up in the receiver's account as "miscellaneous" income or revenue. Like a subsidy, a cash transfer occurs only for one round. Cash transfer is the only method by which the Chairman can grant funds to a department in another jurisdiction.

4. Set Tax Rates ($TAXES)

Taxes constitute the chief source of revenue for the operation of the urban government in City Model. There are four types of local taxes in City Model: Property, income, automobile, and sales. The Chairman may specify the rate at which these taxes are to be levied and the computer will automatically collect the tax revenue. If the Chairman does not set tax rates for a given round, the computer will collect taxes at the previous rate. The methods by which the taxes are calculated by the computer differ for each type of tax.

a. Property Taxes

There are two types of property taxes: land and developments. Land tax is applied to all privately owned land. The tax paid is determined by multiplying the percent of a parcel privately owned times the assessed value of the parcel (set by the assessment department) times land tax rate. Development tax is applied to the economic land use on a given parcel. The tax payment is determined by multiplying the assessed value of development of a parcel times development tax rate.

b. Personal Income Taxes

A political jurisdiction may tax the personal income of either the people who live there or the people who work there. A resident income tax is paid by a population unit and is determined by multiplying the resident income tax rate times gross wages of people who live in a jurisdiction.

Employee income tax is determined by multiplying the employee income tax rate times gross income of the people who work in the jurisdiction.

c. Automobile Taxes

Automobile taxes are also levied by a particular jurisdiction on the people who live there and the people who work there. Automobile resident tax is determined by multiplying the automobile resident tax rate times the travel cost to work by automobile of the people who live in the jurisdiction. Automobile employee tax is determined by multiplying the automobile employee tax rate times the travel cost to work of the people who work in the jurisdiction.

d. Sales Taxes

Sales taxes are levied on all purchasers of business goods and business services and personal goods and personal services. There are separate tax rates for goods and services. The tax is determined by multiplying the sales tax rate on goods/services in the jurisdiction in which the seller is located times the amount of purchase of goods/services at each seller.

5. Set Welfare Payments ($OTHER)

Welfare payments are the equivalent of subsidies to the social sector. The Chairman may set the welfare payment per unemployed worker. The payments are distributed from the current account of the municipal services department and the Chairman should appropriate the necessary funds for these payments to the current account of that department.

Current federal/state aid is available to the municipal services department for welfare payments. It is granted automatically (by the computer) on the basis of two federal/state dollars for each local dollar up to a maximum equivalent to $35 per resident of the jurisdiction.

6. Float Bonds ($OTHER)

Bonds can be defined as loans to the government sector and are an additional source of revenue in City IV. There are two types of bonds available: current and capital. Current bonds are automatically floated by the computer when a department's expenditures exceed its revenues. If the Chairman grants more in appropriations, subsidies and miscellaneous expenditures than he receives in tax revenues, the computer floats a current bond for the Chairman regardless of whether the departments actually spent the money.

A current bond has a term of two rounds and its payments are automatically deducted from the finances of the department or the Chairman in equal installments beginning in the round after the bond is floated. Capital bonds are available to the various departments to finance capital projects. A capital bond has a term of 25 rounds and must be floated by the Chairman. Interest rates on all bonds are determined by the Outside System (the computer). No department may have more than 22 bonds outstanding at one time. All bond payments are made through current accounts (except Planning and Zoning, which has only a capital account).

Further, the total allowable government debt is 15% of the total assessed value of all land and buildings in the jurisdiction. The debt limit for the various departments is 20% (Schools, Highways, Chairman, Utilities), 15% (Municipal Services) and 5% (Planning and Zoning) of the total allowable government debt.

The Bus Company has a total allowable debt of 3% of the total assessed value of all land and buildings on the board and the Rail Company has a total allowable debt of 5% of the total assessed value of land and buildings on the board.

C. The Bureaucracy

1. Common Characteristics

All government departments (except Assessment and Planning and Zoning) share certain characteristics with economic sector land uses. These characteristics are:

a. Development Level

Development level indicates the size of a development. Development level ranges from 1 to 3 for all government land uses. Development level is also a multiplier which affects land requirements, capacity, employment, etc. (i.e., an SC1 requires 16% of a square mile and an SC 2 requires 32% of a square mile).

b. Land Requirements

The land requirement is the amount of land required for a building of the first level of development.

c. Value Ratio

The value ratio is the ratio of present value of a development to its original value, times 100. Value ratio ranges from 0 to 100 and indicates the physical condition of a development.

d. Depreciation

Depreciation is the rate at which a value ratio of a development declines each year. This rate is applied to the original value ratio of a development or equipment (i.e., 100).

e. Maintenance Level

The maintenance level is the level at which the value ratio is to be maintained. Maintaining a development at a specific value ratio involves purchases of business goods (BG) and business services (BS) either from the Outside System or from local BG and BS establishments. The costs of maintenance are automatically deducted by the computer.

The common characteristics of the government land uses are summarized below:

Department	Development Level	Land Requirements	Value Ratio	Depreciation (per annum)	Maintenance Level
Schools (SC)	1-3	16%	0-100	2.0%	0-100
Highways (HY)	1-3	8% (HY1)* 12% (TM1)*	0-100	5.0Z**	0-100
Municipal Services (MS)	1-3	12%	0-100	3.3%	0-100
Utilities (UT)	1-3	20%	0-100	3.3%	0-100
Rapid Rail (RAIL)	1	4% surface tracks	0-100	3.5% (equipment)	0-100
Bus (BUS)	NA	none	0-100	3.5% (equipment)	0-100

2. Source of Income

Aside from appropriations and bonding (previously discussed), there are two other sources of revenue for most governmental departments. These sources are federal/state aid and miscellaneous income.

Federal/state aid is available to Schools, Highways, and Planning and Zoning for capital expenses on federally-approved projects. School and highway aid is for construction at approved sites; Planning and Zoning is for purchases of parkland and is not restricted to specific locations. If capital aid is granted to Schools or Highways, it is in the form of a fixed ratio of aid to local funds spent. Current federal/state aid is also available to the School and Municipal Services Departments. Aid, once granted, is available until spent, limited only to whatever location and level restrictions are imposed. This is explained in more detail in the descriptions of the specific departments.

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[*] HY2 requires 12% and HY3 requires 16%. TM2 requires 16% and TM3 requires 20%

[**] Z is the actual use of a road segment divided by the effective capacity of a road segment.

All public departments may receive income from miscellaneous sources, such as the sale of land they own or cash transfers from other departments or decision-makers in other sectors. Sources of revenue such as this have great potential for varied uses. Cash transfers can often be a gift (or in more realistic terms, a bribe) to insure that a particular decision in the game goes a player's way.

The remainder of this section will deal with the individual departments and the specific characteristics relating to their operation.

D. Assessment Department

The Assessment Department for each jurisdiction makes decisions relating to the taxation of privately owned property (land and developments) represented in the model. This department has the opportunity to operate selectively on the property tax rates. Whereas the Chairman sets the tax rates for land and developments, the Assessment Department controls the assessment rates on all property.

1. Assessment Rate

The assessment rate is the rate at which land and developments are valued in relation to their real market values for tax purposes. For example, a land assessment rate of .50 means that the base to which the land tax is applied is one half (50 percent) of the market value of the land. The development assessment rate is applied to developments owned by economic decision-makers and the land assessment rate is applied only to the percent of privately owned land on a parcel owned by an economic decision-maker.

2. Market Value

a. Land

The market value of all owned land is printed on the Fair Market Value of Land Map. The market value of land will change for either of two reasons:

(1) After construction of a new development or an additional level of development on a parcel.

(2) After the purchase of a parcel by an economic decision maker. The model assumes that the market value of a parcel is always updated by the actual purchase price of a parcel when an economic decision-maker buys a parcel, as long as that price is not less than the previously existing market value.

The market value of unowned land (i.e., owned by the Outside System) is calculated -- but not printed until it is purchased -- on the basis of existing values of surrounding parcels and characteristics such as proximity to highways, terminals, employment, residences and the existence of utilities and zoning.

b. Developments

The market value of developments is determined by multiplying the New Development Value times development level* times value ratio/100. The New Development Values for the various land uses are given below:

Land Use	New Development Value
FL	$ 300,000,000
SG	240,000,000
MP	240,000,000
MF	320,000,000
NL	150,000,000
EL	140,000,000
TE	180,000,000
FO	230,000,000
TA	120,000,000
PA	250,000,000
CR	250,000,000
NS	50,000,000
CI	120,000,000
BG	25,000,000
BS	10,000,000
PG	30,000,000
PS	10,000,000
RA	1,000,000
RB	6,000,000
RC	25,000,000

For example, an FL 2 with a value ratio of 90 would have a market value of $300,000,000 times 2 times .90 or $540,000,000.

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*Development level indicates the size and capacity of a building. There are 3 possible development levels for all land uses except residences, which have fifty.

Once a new development appears on a parcel, the market value of land increases as a function of the Ratio of Land/Development Value. The minimum Ratio of Land/Development Value is summarized for all economic land uses on page 69.

To determine the market value of land with a new development on it, the computer multiplies the New Development Value times the development level times the value ratio/100* times the Ratio of Land/Development Value.

For example, if an HI1 (value ratio = 100) is upgraded to an HI2 (value ratio = 100), the market value of land for the parcel would be $105,000,000 times 2 times 1 tiems .30 or $63,000,000.

There is one exception to this procedure. If the market value of the parcel as determined by the above method is not greater than the previous market value, the higher value will remain.

3. Assessed Value

The assessed value of land and development is determined by multiplying the assessment rate (set by assessment department) tiems the market value of land or development. In the case of land, it must be remembered that the assessment rate is applied only to the market value of the portion of land which is privately owned. For example, suppose economic decision-maker A owns 88% of parcel 9228 and it has a market value of $500,000,000. The market value would be .88 times $500,000,000 or $400,000,000. If the assessment rate is .50, the assessed value of the privately owned land would be $220,000,000. The land tax rate (determined by Chairman) would then be multiplied by that figure to determine the amount of land tax to be paid.

E. Assessment Department Decisions

The Assessment Department may make any or all of the following decisions duirng a round or play:

1. Change Development Assessment Rates (D) for all Land Uses Jurisdiction-Wide.

2. Change Development Assessment Rates for particular land uses only (DHI, DLI, DNS, DCI, DBG, DBS, DPG, DPS, DRA, DRB, DRC). This means that certain developments will have different assessment rates from others.

3. Change Land Assessment Rates (L) for all privately owned parcels Jurisdiction-Wide.

4. Change Land Assessment Rates for parcel with particular land uses (LHI, LLI, LNS, LCI, LBG, LBS, LPG, LPS, LRA, LRB, LRC). This means that parcels with a particular land use on them may be assessed at a different rate rate from other parcels.

5. Define Special Zones. Different development assessment rates; development assessment rates for a particular land use; land assessment rates, or land assessment rates for parcels with a particular land use may be in effect in a special zone. Special zones are one or more parcels where any of these four assessment rates may be applied differently from the rest of the jurisdiction. Special zones are in effect for one round only, and if they are to remain in subsequent rounds, they must be redefined.

MINIMUM RATIO OF LAND/DEVELOPMENT VALUE

Land Use	New Development Value*	Minimum Ratio of Land/Development Value
FL	$ 300,000,000	30.0%
SG	240,000,000	30.0%
MP	240,000,000	30.0%
MF	320,000,000	30.0%
NL	150,000,000	30.0%
EL	140,000,000	30.0%
TE	180,000,000	30.0%
FO	230,000,000	30.0%
TA	120,000,000	30.0%
PA	250,000,000	30.0%
CR	250,000,000	30.0%
NS	50,000,000	30.0%
CI	120,000,000	30.0%
BG	25,000,000	25.0%
BS	10,000,000	25.0%
PG	30,000,000	25.0%
PS	10,000,000	25.0%
RA	1,000,000	20.0%
RB	6,000,000	10.0%
RC	25,000,000	5.0%

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*These figures assume a value ratio (or quality index for residences) of 100. Value ratio and quality index indicate the physical condition of a building. For example, a BG with a value ratio of 75 has depreciated by a factor of 25% of its original development value.

6. Make Special Assessments for individual parcels. In this case the Assessment Department may override the existing value and input its own assessed value for a particular parcel of land or a particular development.

When making decisions and coding them on the input decision form, the decision-maker representing the Assessment Department must be careful to observe a certain order. All jurisdiction-wide assessment decisions must be made first. After these decisions are made, special zones may be defined. The special rates which are to be in effect in a special zone must follow immediately after that particular zone is defined; otherwise, the computer will impose the same rates as have been previously specified on a jurisdiction-wide basis. Finally, only special assessments for a particular parcel may be made after special zone rates are specified. To summarize the order of assessment decisions:

1. Change assessment rates jurisdiction-wide.
2. Define special zones
3. Specify assessment rates for the special zone just defined.
4. Make special assessments

All assessment decisions are in effect for one round only.

F. School Department (SC)

1. Employment and Capacity

The School Department hires teachers from the high (PH) and middle (PM) income population units only. There are 120 teachers in a PH and 160 teachers in a PM.

Schools have an optimal employment mix. This mix, however, does not determine output, but rather the number of students which a school can serve (i.e., design capacity).

This relationship is given below for an SC1:

Design Capacity (students) as a Function of Employment Mix

PM Units	0	1	2	3	4	5	6
PH Units							
0		2,520	4,140	6,840	9,900	12,240	13,140

The relationship given for an SC1 continues below:

Design Capacity (students) as a Function of Employment Mix

PM Units	0	1	2	3	4	5	6
PH Units							
1	3,600	5,910	8,460	11,200	13,320	15,300	17,100
2	7,200	9,900	12,600	15,500	17,460	19,440	21,240
3	10,800	14,040	16,920	20,000	21,960	23,760	25,560
4	13,140	17,460	21,060	23,400	25,200	27,000	28,620
5	17,100	20,700	23,400	26,640	28,440	30,000	31,500
6	19,800	23,850	26,820	29,880	31,320	32,850	34,200

The optimal employment mix of an SC1 is 3 PM teachers and 3PH teachers. This mix creates a design capacity of 20,000 students. The per student cost (In salaries) increases.*

The value ratio also affects capacity. For example, the design capacity of an SC1 with 2 PH teachers and 4 PM teachers is 17,460 students, but its effective capacity is determined by multiplying its design capacity times value ratio/100. Therefore, the effective capacity of the SC1 with a value ratio of 80 would be:

$$17460 \times \frac{80}{100} = 13{,}968 \text{ students}$$

The use index of a school is determined by dividing its use by its effective capacity and multiplying the result by 100. If the use index is greater than 100, the school is overcrowded. Overcrowded schools contribute to dissatisfaction and thus to migration in the social sector.

2. School Assignments

Students are assigned to schools by the computer Middle and high income families have certain criteria for the school in their district. If the school fails to meet these criteria, these students will be assigned by the computer to private schools at the expense of the population unit they represent. For high income students the school must have (1) a student/teacher ratio of at least one teacher per 18 students, (2) a value ratio above 80, and (3) at least 1 PH teacher unit for every PM teacher unit. Middle income students will not attend public school unless there is (1) a student/teacher ratio no greater than 21-1 (2) a value ratio of 60 and (3) at least 3 PH teacher units to every 4 PM teacher units. Students of the low socio-economic class go to the public school in their district regardless of the high and middle class criteria, unless their residence location is excluded from a district. The costs of private education are $37,500 per PH (130 Students), $25,000 per PM (140 Students), and $12,500 per PL (100 Students).

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*Development levels indicate the size of a building and are multiples for other factors as well. For example, a SC2 with 6 PH teachers and 6 PM teachers has a design capacity of 40,000 students.

3. Adult Education

The School Department can offer courses in adult education on a jurisdiction-wide basis. Thus, adult education is not tied to a particular location or school. The number of population units hired from the PH and PM classes on part-time basis determines the capacity of the adult education program to serve population units who allocate time for free adult education.

All adult education teachers are part-time workers. The department indicates the number of time units to be hired from the high and/or middle population classes. One part-time employment unit of middle income teachers supplies one adult teacher unit while one part-time employment unit of high income teachers supplies one-and-one-half adult teacher units. One adult teacher unit provides 10 units of adult education. Adult education teachers are paid the same way all part-time workers are paid; on a percent basis of the full-time job they fill. (See Social Sector: Time Allocation).

The requirements for part-time education are summarized below:

Teachers	Typical Cost of One Part-Time Teacher Unit	Units of Adult Education Per Part-Time Teacher Unit
PH	$15,000	15
PM	$10,000	10

4. Revenues

The School Department receives revenue to its current and capital accounts from various sources. These include:

a. Appropriations. These are funds distributed to the current and/or capital account of the department by the chairman.

b. Federal/State Aid. Current federal/state aid is automatically granted to the department in the amount of $225 for each student enrolled in public schools in the jurisdiction. Capital federal/state aid may be applied to the construction of new schools.

c. Bonds. Current bonds are automatically floated by the computer if the current expenditures of the department exceed its current revenue. Current bonds have a duration of two years and the interest rate is set by the computer. Capital bonds may be floated for a department by the Chairman, subject to a referendum by the social sector. Capital bonds have a duration of 25 years and interest rate is set by the computer.

d. Miscellaneous. These revenues include such items as cash transfers to the capital or current accounts of the department and income from the sale of land (capital account only).

5. Expenditures

The School Department spends money on the following items:

a. Goods and Services. The School Department must purchase business goods (BG) and business services (BS) for the normal operation of its schools and for the maintenance and/or renovation of its schools. BG and BS may be purchased either from establishments owned by local economic decision-makers (competitive prices usually range around $100,000 per unit) or from the Outside System (i.e., the computer) at fixed prices of $130,000 per unit. Goods and services are purchased locally only if contracts are made.

The goods and services requirements of a level one school (SC1) are outlined below:

	BG	BS
For Renovation and/or Maintenance	2 units	.7 units
For Normal Operation of an SC1	8 units	3 units

b. Full-Time Salaries. The typical salary for a PH worker is $10,000, and the typical salary for a PM worker is $5,000. There are 120 workers (teachers) in a PH and 160 workers (teachers) in a PM.

c. Miscellaneous. These expenditures include cash transfers from the capital or current accounts of the department to an economic or government decision-maker, or from one account to another account.

d. Bond Payments. These include payments on interest and principal of outstanding capital bonds and current bonds floated by the department.

e. Adult Education. These are salaries for part-time workers for adult education. On PH part-time teacher unit costs $15,000 and supplies 15 units of adult education. One PM part-time teacher unit costs $10,000 and supplies 10 units of adult education.

f. School Construction. This includes funds expended for the construction of a new school, the up-grading of an old one, or the demolition of a school. The "typical" cost of an SC1 is $27,000,000. If a local construction industry (CI) does not offer a fair price, a school can be constructed by the Outside System at a fixed cost of $35,100,000. The "typical" demolition cost for an SC1 is $5,400,000. The fixed demolition cost (Outside System) is $7,020,000.

g. Land Purchase. This includes expenditures for the purchase of land from government or economic decision-makers or the Outside System.

G. School Department Decisions

The School Department is responsible for providing educational facilities to the residents of the simulated area. In order to accomplish this, the School Department may make any or all of the following decisions: purchase land, change employment, change maintenance level, make contracts for BG and BS purchases, change district boundaries, transfer cash, change salaries, build schools, request federal/state aid, and provide adult education.

1. Purchase Land ($PU)

The School Department may purchase land from either of two sources: another decision-maker who owns the parcel or the Outside System (i.e., the computer).

When purchasing land from another decision-maker the department must buy undeveloped land in portions of 4% of a square mile (i.e., 4, 6, 12, 16, ... 92, 96, 100%) and the terms of the purchase are arrived at by mutual agreement. When bidding on land owned by the computer, the department must also purchase lots in portions of 4%. The bidding price may be determined from the Fair Market Value Map or from other sources at the disposal of the department.

2. Change Employment ($CVPT)

The School Department has an employment mix which describes its capacity of students. Further, the ratio of PH to PM teachers affects what classes of students will attend a particular school. The School Department can request a different employment mix at any school and if there are PH and PM workers available and fair salaries are offered, the computer will assign new teachers to that school.

3. Change Maintenance Level ($CVPT)

Each school has a value ratio which describes the quality of the building, affects capacity, and determines the type of students who will attend that school. School buildings depreciate at a constant rate of 2% per round. Decision-makers in the School Department can counter the effects of depreciation (i.e., a declining value ratio) by specifying a maintenance level at which the value ratio of a school is to be maintained. Maintenance and/or renovation (i.e., raising the maintenance level above value ratio) involves purchases of business goods and business services either from local BG and BS establishments or from the Outside System.

4. Award Contracts ($CVPT)

The School Department purchases business goods (BG) and business services (BS) for the maintenance and normal operation of each of its schools. The department may contract to buy from local BG and BS establishments owned by economic decision-makers (competitive prices ususally range around $100,000 per unit), or it will automatically buy from the Outside System at $130,000 per unit of BG or BS.

5. Change District Boundaries ($REDIST)

Each school serves a school district and there must be only one school per district. The original districts are printed on first round computer maps. The decision-maker representing the School Department may alter district boundaries at any time. This allows him to do such things as relieve overcrowding in one district if there is an under-crowded school in an adjacent district. Two districts may not overlap (i.e., serve same parcel), nor can they be discontinuous. The parcel on which a school is located is automatically in its district.

6. Transfer Cash ($CASH)

The School Department may transfer cash between its own capital or current accounts, to the capital or current accounts of other departments or to the Chairman, or to an economic decision-maker.

7. Change Salaries ($OTHER)

The School Department is in competition with establishments in the economic sector for PH and PM workers to fill teaching positions. The typical salary for a PH worker is $10,000, and the typical salary for a PM worker is $5,000. The School Department may change salaries at any time, but when doing so, the changes go into effect for all teachers and not just those at a given school.

8. Build Schools ($BUILD or $OUBLD)

The School Department may build new schools, upgrade (i.e., add an additional level of development), or demolish old ones. Construction may be accomplished either by the local CI or by the Outside System at 1.3 times the typical cost. The typical construction cost of an SC1 is $27,000,000 and the demolition cost is $5,400,000 by a CI. Schools may be located on any parcel, but only one school can be on a parcel. All construction requires one full round to complete. An SC1 requires 16% of a square mile.

9. Request Federal/State Aid ($FSA)

Schools are eligible for two types of Federal/state aid: current and capital. The School Department automatically receives aid for current expenditures in the amount of $225 for each student enrolled in the system.

Decision-makers must request Federal/state aid for capital expenditures (i.e., the construction of new facilities). If granted, it must be matched dollar for dollar by local funds. Aid for construction and upgrading on a maximum of 3 schools, if the city is under 1,000,000 in population, and for two more schools for each additional million of population in the city may be requested each round. If aid is approved for a construction site, the aid is available for only that location and only up to the approved development level. There is a 60% chance of acceptance of the first request if the ratio of students per school (first level of development) is about 18,000/1. The chances increase slightly as the ratio increases. The second request has a 40% chance of acceptance, which varies with the same criteria. All other requests have a 30% chance. Aid should be requested one round before construction is intended.

10. Request Teachers for Adult Education ($OTHER)

The School Department can provide adult education by specifying the number of high and middle income units in adult education requested. These units will be provided if sufficient part-time teachers are available.

H. Municipal Services Department (MS)

The function of the Municipal Services Department is to provide the equivalent of fire, police and sanitary service to the simulated area. This service is expressed in terms of MS units.

1. Employment and Capacity

The Municipal Services Department employs from the middle (PM) and low (PL) income population units only. There are 160 workers in a PM and 200 workers in a PL unit. Like schools, the design capacity of an MS plant is determined by its employment mix. This relationship is summarized below for a level one plant (MS1):

Design Capacity (MS units) as a Function of Employment Mix

PL Worker Units	0	1	2	3	4	5	6
PM Worker Units							
0		140	230	380	500	680	730
1	200	330	470	620	740	850	950
2	400	550	700	860	970	1,080	1,180
3	600	780	940	1,100	1,220	1,320	1,420
4	730	970	1,170	1,300	1,400	1,500	1,590
5	950	1,150	1,300	1,480	1,580	1,670	1,750
6	1,100	1,325	1,490	1,660	1,740	1,825	1,900

The optimal employment mix of an MS1 is 3 PM workers and 3 PL workers. This mix creates a design capacity of 1,100 MS units. The per unit cost (in salaries) of operating an MS1 is least at this mix. At any other employment mix the per unit cost (in salaries) increases.*

Value ratio also affects the capacity of an MS plant. For example, an MS1 with 4 PL workers and 2 PM workers has a design capacity of 970 MS units. The effective capacity of an MS plant is determined by multiplying its design capacity times the value ratio/100. Suppose that the value ratio was 80, the effective capacity would be:

$$970 \times \frac{80}{100} = 776 \text{ MS units}$$

2. Drain on Municipal Services

As in a real city, all private developments require municipal services. The drain (or "loading") of MS units by the various land uses at the first level of development is summarized on the next page.

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*Development levels indicate the size of a building and are multiples for other factors as well. For example, an MS2 with 6 PM workers and 6 PL workers has a design capacity of 2,200 MS units.

DRAIN OF MS UNITS BY LAND USES

Land Use	Drain (MS Units)
FL1	150
SG1	50
MP1	200
MF1	150
NL1	100
EL1	150
TE1	200
FO1	250
TA1	150
PA1	200
CR1	300
NS1	50
BG1	25
BS1	10
PG1	30
PS1	10
RA1	10
RB1	60
RC1	250

The quality of MS service affects depreciation of economic land uses and social sector dissatisfaction. Quality of service deteriorates when effective capacity. The factor by which land uses served by an MS plant depreciate is expressed in terms of the MS Use Index.

$$\text{MS Use Index} = \frac{\text{Actual Number of MS Units Drained} \times 100}{\text{Effective Capacity of MS Plant}}$$

(Note: An MS Use Index will never be computed above 200.)

In other words, an MS plant with a Use Index greater than 100 is being overused and depreciation and dissatisfaction will be increased.

3. Revenues

The Municipal Services Department receives income for its current and capital accounts from various sources. These include:

a. Appropriations. These are funds distributed to the current and/or capital accounts of the department by the Chairman.

b. Federal/State Aid. Current federal/state aid is automatically granted to the department for welfare payments. Aid is granted to the department for welfare payments. Aid is granted on the basis of two federal/state dollars for each local dollar up to a maximum equivalent to $35 per resident of a jurisdiction. The Municipal Services Department is not eligible for capital federal/state aid.

c. Miscellaneous. This income includes such items as cash transfers to the capital or current account of the department and income from the sale of land (capital account only).

d. Bonds. Current bonds are automatically floated by the computer if the current expenditures of the department exceed its current revenue. Current bonds have a duration of two years and the interest rate is set by the computer. Capital bonds may be floated for a department by the chairman, subject to a referendum by the social sector. Capital bonds have a duration of 25 years and the interest rate is set by the computer.

4. Expenditures

The Municipal Services Department spends money in the following items:

a. Welfare Payments. Welfare payments for unemployed workers are specified by the Chairman but distributed from the current accounts of the Municipal Services Department.

b. Goods and Services. The Municipal Services Department must purchase business goods (BG) and business services (BS) for the normal operation of its plants and for the maintenance and/or renovation of its plants. BG and BS may be purchased from either local establishments owned by economic decision-makers (competitive prices usually range around $100,000 per unit) or from the Outside System (i.e., the computer) at fixed prices of $130,000 per unit. Contracts must be made if purchases are to be from local establishments.

The goods and services requirements of a level one plant (MS1) are outlined below:

	BG	BS
For 1% Renovation and/or Maintenance	2 units	1 unit
For Normal Operation of an MS1	7 units	3 units

c. Miscellaneous. These expenditures include cash transfers from the capital or current accounts of the department to another government or economic decision-maker, or from one account to another account.

d. Salaries. The typical salary for one PM worker is $5,000, and the typical salary for one PL worker is $2,500. There are 160 workers in a PM and 200 workers in a PL unit.

e. Bond Payments. These include payments on interest and principal of outstanding capital and current bonds floated by the department.

f. Construction. This includes funds expended for the construction of a new MS plant or the demolition of an old one. The "typical" cost of an MS1 is $30,000,000. If a local construction industry (CI) does not offer a fair price, an MS plant can be constructed by the Outside System at a fixed cost of $39,000,000. The "typical" local demolition cost is $6,000,000 and the fixed demolition cost (Outside System) is $7,800,000.

g. Land Purchase. This includes expenditures for the purchase of land either from a government or economic decision-maker or from the Outside System.

I. Municipal Services Decision

In order to provide adequate services to the city, the Municipal Services Department may make any or all of the following decisions during a round of play: Purchase land, change employment, change maintenance level, make contracts for BG and BS purchases, change district boundaries, transfer cash, change salaries, build, upgrade or demolish MS plants.

1. Purchase Land ($PU)

The Municipal Services Department may purchase land from either of two sources: another decision-maker who owns land or the Outside System (i.e., the computer). When purchasing land from another decision-maker, the department must buy undeveloped land in portions of 4% of a square mile (i.e., 4, 8, 12, 16, ... 92, 96, 100%) and the terms of the purchase are arrived at by mutual agreement. When bidding on land owned by the Outside System, the department must also purchase lots in portions of 4%. The bidding price may be determined from the Auction Asking Price Map.

2. Change Employment ($CVPT)

Like the School Department, the Municipal Services Department has an employment mix which describes its capacity to produce MS service (i.e., MS units) to the community. The Municipal Services Department can request a different employment mix at any MS plant, and if there are PM and PL workers available and adequate salaries are offered, the computer will assign new workers to that plant.

3. Change Maintenance Level ($CVPT)

Each MS plant has a value ratio which describes the quality of the building and affects the ability of that plant to produce at its design capacity. MS plants depreciate at a constant rate of 3.3% per round. Decision-makers in the Municipal Services Department can counter the natural effects of depreciation (i.e., a declining value ratio) by specifying a maintenance level at which the value ratio of an MS plant is to be maintained. Maintenance and/or renovation (i.e., raising the maintenance level above the value ratio) involves purchases of business goods and business services either from local BG and BS establishments or from the Outside System.

4. Award Contracts ($CVPT)

The Municipal Services Department purchases business goods (BG) and business services (BS) for the maintenance and normal operation of each of its plants. BG and BS may be purchased either from local BG and BS establishments as the result of a contract agreement (the competitive price usually ranges around $100,000 per unit) or from the Outside System at a fixed price of $130,000 per unit.

When awarding contracts for BG or BS, the department must specify the location of the BG or BS establishment, the percentage of its total purchases which it will buy there, as well as the priority which it awards to each establishment.

5. Change District Boundaries ($REDIST)

Each MS plant must serve an MS district and there must only be one MS plant per district. The original districts are printed on first round computer maps. The decision-maker representing the Municipal Services Department may alter district boundaries at any time. This allows an alternative course of action to building a new plant or upgrading or renovating an old one which is operating over capacity when the plant in an adjacent district may be under capacity. Two districts may not overlap (i.e., serve the same parcel), nor can a district be discontinuous. The parcel on which an MS is located is automatically in its district.

6. Transfer Cash ($CASH)

The Municipal Services Department may transfer cash between its own capital and current accounts, to the capital or current accounts of other departments or the Chairman, or to an economic decision-maker.

7. Change Salaries ($OTHER)

The Municipal Services Department is in competition with business establishments in the economic sector for PM and PL workers to fill jobs. The typical salary per PM worker is $5,000 and the typical salary per PL worker is $2,500.

8. Build, Upgrade or Demolish MS plants ($BUILD or $OUBLD)

The Municipal Services Department may build new MS plants, upgrade (i.e., add an additional level of development) or demolish old ones. Construction may be accomplished either by the local CI or by the Outside System at 1.3 times the typical cost. The typical construction cost of an MS1 is $30,000,000 and the typical demolition cost is $6,000,000. An MS1 can be built by the Outside System at a fixed cost of $39,000,000 and demolished at a fixed cost of $7,800,000. MS plants may be located on any parcel, but only one MS can be on a parcel. All construction requires one full round to complete. An MS1 requires 12% of a square mile.

J. Highway Department (HY)

The Highway Department is concerned with two types of developments: highways and terminals.

1. Highways

a. Types. There are three types of highways in City IV: HY1, HY2, and HY3. An HY3 is the largest road and it requires 16% of land from each side of the road. An HY2 requires 12% from each side and an HY1 requires 8% from each side. The type of highway (i.e., its "size") determines its design capacity. The design capacity of the three types of highways are 500 road units (HY1); 1000 road units (HY2); and 1500 road units (HY3) per mile segment.

The value ratio of a segment of highway will reduce its design capacity by a function of VR/100 times design capacity; the product is equivalent to effective capacity.

Roads are used by population units to travel to and from employment and shop locations and by basic industry (HI, LI, NS) and commercial establishments (BG, PG, PS) to transport products to terminals and to purchase the necessary goods and services for maintenance and normal operations. Population units travel to work during peak-hour travel only. A population unit consumes 10 road units per mile when traveling to and from work by automobile. Buses also consume road units during peak-hour. A bus (level 1) requires 50 units per mile; a bus (level 2) requires 100 units per mile, and a bus (level 3) requires 150 units per mile.

b. Depreciation. Highways depreciate as a function of use. The annual depreciation rate of a mile segment of highway is 5.0Z where Z is the actual number of road units consumed divided by effective capacity of the road segment.

c. Congestion. Congestion occurs when the use index ((Actual Use/Effective Capacity) x 100) of a highway is greater than 100. Congestion is recorded only during peak-hour travel. When congestion occurs, it takes additional time for population units to travel on highways in the city. The amount of additional time is directly proportional to the amount of congestion on the highway. For example, if the peak-hour congestion is 110%, the time to travel a road is 10% greater than otherwise. Time consumed in transportation to and from work affects the allocation of leisure time in the social sector.

2. Terminals

Terminals (TM) are used by HI, LI, and BG. HI and LI use terminals to ship output to national demanders and BG receives goods from national suppliers. A TM1 supplies 10,000 capacity units; a TM 2 supplies 20,000 capacity units; and a TM3 supplies 30,000 capacity units. The consumption requirements of TM users are summarized on the following page.

Land Use	Terminal Capacity Units Consumed
HI	3,000
LI	1,000
BG	1 per unit sold

A terminal can only be in an intersection. Land requirements for terminals are 12% (TM1); 16% (TM2); and 20% (TM3) from each of four corners.

3. Revenues

The Highway Department receives income to its current and capital accounts from various sources. These include:

a. Appropriations. These are funds distributed to the current and/or capital accounts of the department by the Chairman.

b. Federal/State Aid. The Highway Department is eligible for capital federal/state aid for the construction of new highways or the upgrading of existing ones. Aid must be requested from the computer. The chances of a request being accepted are 80% for type 1 construction, 50% for type 2 construction, and 30% for type 3 construction. The matching ratio of federal/state funds to local funds for a HY1 is 1 federal/state dollar to 9 local dollars; for a HY2, 1:1; and for a HY3, 2:1.

c. Bonds. Current bonds are automatically floated by the computer if the current expenditures of the department exceed its current revenue. Current bonds have a duration of two years and the interest rate is set by the computer. Capital bonds may be floated for the department by the Chairman subject to a referendum by the social sector. Capital bonds have a duration of 25 years and the interest rate is set by the computer.

d. Miscellaneous. This income includes such items as cash transfers to the capital or current account of the department and income from the sale of land (capital account only).

4. Expenditures

The Highway Department spends money on the following items:

a. Road Maintenance. The Highway Department must purchase business goods (BG) and business services (BS) for the maintenance and/or renovation of its roads. BG and BS are purchased by the Highway Department at fixed costs from the Outside System. The goods and services costs per mile maintained for 1% renovation and/or maintenance are outlined below:

Road Type	BG	BS
HY1	$ 7,000	$1,000
HY2	14,000	2,000
HY3	21,000	3,000

b. Bond Payments. These include payments on interest and principal of outstanding capital and current bonds floated by the department.

c. Miscellaneous. These expenditures involve cash transfers from the capital or current accounts of the department to an economic or governmental decision-maker, or from one account to another account.

d. Road and Terminal Construction. The Highway Department can build, upgrade or demolish highways and terminals. The "typical" cost of a HY1 is $800,000 per mile, and the "typical" demolition costs of $160,000 per mile and $2,800,000, respectively. If a local construction industry (CI) does not offer a fair price, building can be done by the Outside System at fixed prices of $1,040,000 per mile of HY1 and $18,200,000 for a TM1. Outside System demolition costs are $208,000 per mile for a HY1 and $3,640,000 for a TM1.

e. Land Purchase. This includes expenditures for the purchase of land either from a governmental or economic decision-maker or from the Outside System.

f. Miscellaneous. These expenditures involve cash transfers from the capital or current accounts of the department to another government or economic decision-maker, or from one account to another account.

K. Highway Department Decisions

The Highway Department is responsible for all roads and terminals in the simulated city. The Highway Department may make any or all of the following decisions during a round of play: purchase land, transfer cash, change maintenance levels, build highways and terminals, request federal/state aid.

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*Although an HY2 does not require twice as much land as an HY1, its construction cost is double that of an HY1. Likewise, an HY3 costs three times that of an HY1. A TM2 costs twice as much and a TM3 three times as much as a TM1.

1. Purchase Land ($PU)

The Highway Department may purchase land from either of two sources: another decision-maker or the Outside System (i.e., the computer). When purchasing land from another decision-maker, the department must buy undeveloped land in portions of 4% of a square mile (i.e., 4, 8, 12, 16 ... 92, 96, 100%) and the terms of the purchase are arrived at by mutual agreement. When bidding on land owned by the Outside System, the department must also purchase land in portions of 4%. The bidding price may be determined from the Fair Market Value Map or from other sources available to the department.

When purchasing land for the purpose of building highways, it is important to remember that highways require land form both sides of the road. These requirements are 8% from each side for HY1, 12% from each side for HY2 and 16% from each side for HY3. Terminals require land from all four corners of an intersection. These requirements are 12% from each corner for a TM1, 16% from each corner for a TM2 and 20% from each corner for TM3.

2. Transfer Cash ($CASH)

The Highway Department may transfer cash between its own capital and current accounts, to the capital or current accounts of other departments or the Chairman or to an economic decision-maker.

3. Change Maintenance Level ($CVPT)

Each type of highway (HY1, HY2, HY3) has a value ratio which describes the quality of the road and affects its capacity. Highways depreciate at a yearly rate of .05Z and where Z is the actual number of road units consumed divided by the effective capacity of the road. Decision-makers in the Highway Department can counter the effects of depreciation (i.e., a declining value ratio) by specifying a maintenance level at which the value ratio of each type of highway is to be maintained. Maintenance and/or renovation (i.e., a declining value ratio) by specifying a maintenance level at which the value ratio of each type of highway is to be maintained. Maintenance and/or renovation (i.e., raising the maintenance level above the value ratio) involves purchases of business goods (BG) and business services (BS) at fixed costs from the Outside System.

4. Build Highways and Terminals ($BUILD or $OUBLD)

The Highway Department may build new highways or terminals, upgrade (i.e., add an additional level of development) or demolish old ones. Construction may be accomplished by either a local CI or the Outside System at 1.3 times the typical cost. Typical construction costs are $800,000 per mile for an HY1 and $14,000,000 for a TM1. Demolition costs are $160,000 for an HY1 and $2,800,000 for a TM1. Highways and terminals can also be built and/or demolished by the Outside System at fixed costs. Construction costs are $1,040,000 (HY1) and $18,200,000 (TM1). Demolition costs are $208,000 (HY1) and $3,640,000 (TM1). Terminals must be located on intersections and road units located on road beds (i.e., vertical and horizontal coordinates). All construction requires one full round to complete.

5. Request Federal/State Aid ($FSA)

The Highway Department is eligible for capital federal/state aid for the construction of new highways and the upgrading of highways at specified locations. The chances of a request being granted are about 80% for construction of level one highways, 50% for construction of level two highways, and 30% for construction of level three highways. The matching ratio of federal/state funds to local funds for one level of construction is 1:9; for two levels of construction, 1:1; and for three levels of construction, 2:1.

L. Planning and Zoning Department (PZ)

The Planning and Zoning Department is responsible for zoning, the acquisition of parkland and the creation and demolition of public institutional land.

1. Zoning

As the name of the department implies, the powers of this department go somewhat beyond zoning. This department has the powers at its disposal to develop a master plan for the city for future redevelopment. It may regulate at its discretion the location of all private construction by enforcing zoning codes to which private developers must conform. The implication of this power is that the players can exercise control over the type of development built in the city. They have the ability to zone areas for suburban residential development, industrial parks, recreation areas, etc., at their own discretion. The amount of planning which would be instituted is up to the individual players representing the Planning and Zoning Department.

2. Parkland and Public Institutional Land

The Planning and Zoning Department has responsibility for two types of public land uses: parkland and public institutional land. Parkland is equivalent to open space recreational areas and is used by the social sector when they allocate time to recreation. Public institutional land is equivalent to parkland with developments and represents such things as museums, zoos, libraries and public golf courses. Public institutional land can be created on a parkland at a cost of $1,000,000 per 4% of a parcel. Demolition costs per 4% are $200,000. All costs are paid to the Outside System.

3. Revenues

The Planning and Zoning Department receives income to its capital account (it has no current account) from various sources. These include:

a. Appropriations. These are funds distributed to the department by the Chairman.

b. Bonds. Capital bonds may be floated for the department by the Chairman subject to the approval of the social sector. Capital bonds have a duration of 25 years and the interest rate is set by the computer.

c. Federal/State Aid. The Planning and Zoning Department is eligible for capital federal/state aid for the purchase of parkland, which may later be developed as public institutional land use.

d. Miscellaneous. This income includes such items as cash transfers to the capital account of the department and income from the sale of land.

4. Expenditures

The Planning and Zoning Department spends money on the following items:

a. Bond Payments. This includes payments on interest and principal of outstanding capital bonds floated by the department.

b. Land Purchase. This involves purchases of undeveloped land from a governmental or economic decision-maker or the Outside System for the purpose of providing parkland.

c. Public Institutional. This is an expenditure for the development of parkland into public institutional use. Demolition of public institutional uses is included in this item.

d. Miscellaneous. These expenditures involve cash transfers from the capital account of the department to an economic or governmental decision-maker.

M. Planning and Zoning Department Decisions

In order to accomplish its objectives, the Planning and Zoning Department may make any or all of the following decisions during a round of play: purchase land, change zoning, transfer cash, request federal/state aid, and create or demolish institutional land uses.

1. Purchase Land ($PU)

The Planning and Zoning Department may purchase land from either of two sources: another decision-maker or the Outside System (i.e., the computer). When purchasing land from another decision-maker, the department must buy undeveloped land in portions of 4% of a square mile (i.e., 4, 8, 12, 16, ... 92, 96, 100%) and the terms of the purchase are arrived at by mutual agreement. When bidding on land owned by the Outside System, the department must also purchase land in portions of 4%. The bidding price may be determined from the Fair Market Value Map or from other sources available to the department.

Any undeveloped land owned by the Planning and Zoning Department is parkland (unless developed in public institutional use) and is used by population units for recreation. One square mile of parkland provides recreational space for 120,000 time units of time allocated for recreation.

2. Change Zoning ($CVPT)

The Planning and Zoning Department may change the zoning of any parcel at any time. The various zoning codes in City IV are:

Land Use	Classification
Any Use	00 or --
Any Business	10
Any Manufacturing	20
HI *	21
LI *	22
CI	23
All Non-Manufacturing	30
NS	31
BG	32
BS	33
PG	34
PS	35
Any Residential	40
RA	41
RB	42
RC	43
Parkland	50

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*NOTE: HI and LI refer to the eleven SIC categories.

The original zoning for the simulated area is printed on first round computer maps. If the zoning for a parcel with an economic land use on it is changed to a code prohibiting that land use, it means that no further increments (levels of development) of that land use can be built there.

3. Transfer Cash ($CASH)

The Planning and Zoning Department may transfer cash to the capital or current accounts of other departments or to the Chairman, or to an economic decision-maker.

4. Request Federal/State Aid ($FSA)

The Planning and Zoning Department may file up to 3 requests per round for capital federal/state aid for the purchase of parkland. Aid for parkland does not need to be specified for specific locations. The chances of a request being granted are about 15%, but the probability of acceptance increases as the amount of request decreases and the existing ratio of population/square mile of parkland increases.

5. Create or Demolish Public Institutional Land Uses ($CVPT)

The department may develop parkland into public institutional uses at a cost of $1,000,000 per 4% of a parcel (demolition costs $200,000 per 4% of a parcel). All costs are paid to the outside economy. One square mile of public institutional land can serve 100,000 people on the national average.

N. Utility Department (UT)

The Utility Department is responsible for providing utilities such as gas, water and electric power to economic developments. Units of utility service are provided by utility plants. Utility plants have three possible development levels. A UT1 requires 20% of a square mile.

1. Installation of Service

When providing service to a parcel, the Utility Department installs levels of service.* There may not be more than nine levels of service on a parcel. Each level of service provides a certain number of utility units. At least as many units must be provided as an economic activity requires for operaiton. Once supplied service may not be taken away from a parcel. The installation costs for providing levels of service are fixed and deducted from the financial accounts of the department by the computer. This information is summarized on the following page.

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*Levels of Service installed on a parcel (1 through 9) should not be confused with the development level (1 through 3) of a utility plant.

Levels of Service	Installation Costs	Utility Units Installed
1	$ 2,000,000	100
2	4,000,000	200
3	5,000,000	300
4	6,000,000	400
5	8,000,000	500
6	11,000,000	600
7	14,000,000	700
8	18,000,000	900
9	28,000,000	1,300

There is no design capacity of a utility plant. In terms of operating cost, however, a UT1 has a least cost (per unit) capacity of 1500 units. The variable cost function of a UT1 is given below:

Utility Units Served	Per Unit Operating Cost	Total Operating Cost
300	$20,000	$ 6,000,000
600	13,333	8,000,000
900	9,629	8,666,667
1,200	7,777	9,333,333
1,500	6,667	10,000,000
1,800	7,407	13,333,333
2,100	7,936	16,666,667
2,200	8,080	17,777,778
2,500	8,444	21,111,111
2,800	8,730	24,444,444

(NOTE: If 1500 units is the least cost capacity of a UT1, this means that if the per unit operating cost is above $6,667, the plant is not operating at its optimum productivity level. Maximum profit also occurs at 1500 units served.)

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* Levels of Service installed on a parcel (1 through 9) should not be confused with the development level (1 through 3) of a utility plant.

The units which a utility plant serves are the equivalent of the drain of utility units by the land uses which require utility service. The utility requirements of the various land uses are given on page 93.

2. Revenues

Unlike other departments, the Utility Department is a quasi-private company and cannot receive income to its current or capital accounts from direct appropriations from the Chairman. The department can, however, receive income from any of the following sources:

a. Subsidies. These are public subsidies granted by the Chairman to the current or capital accounts of the department.

b. Bonds. Current bonds are automatically floated by the computer if the current expenditures of the department exceed its revenues. Current bonds have a duration of two years and the interest rate is set by the computer. Capital bonds may be floated for the department by the Chairman, subject to a referendum by the social sector. Capital bonds have a duration of 25 years and the interest rate is determined by the computer.

c. Miscellaneous. These revenues include such items as cash transfers to the capital or current accounts of the department and income from the sales of land (capital account only).

d. Income from Users. Since the Utility Department can set a price for its service, it earns income for every unit of service which is consumed by the economic sector land uses. The "typical" price charged all utility charges from the accounts of the economic activities and credits income to the Utility Department.

UTILITY REQUIRMENTS OF VARIOUS LAND USES

Land Use Type*	Utility Requirements (Units)
FL1	50
SG1	100
MP1	700
MF1	100
NL1	100
EL1	200
TE1	200
FO1	300
TA1	100
PA1	300
CR1	400
NS1	76
BG1	112
BS1	71
PG1	99
PS1	77
RA1	4
RB1	26
RC1	117

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*Development level is a multiple for determining utility requirements. For example, a PG3 would require 297 utility units.

3. Expenditures

The Utility Department spends money on the following items:

a. Operating Costs. Total operating costs were discussed earlier. Operating costs increase with the number of utility units served; but the per unit operating cost is least at 1500 units.

The methods for determining operating costs are outlined below:

Let X = the number of utility units drained if $X \leq 600$,

$$\text{Cost} = \frac{\$4,000,000}{600}(X) + \$4,000,000$$

if $600 < X \leq 1,500$,

$$\text{Cost} = \frac{\$2,000,000}{900}(X - 600) + \$8,000,000$$

if $X > 1,500$,

$$\text{Cost} = \frac{\$10,000,000}{900}(X - 1500) + \$10,000,000$$

b. Miscellaneous. These expenditures include cash transfers from the capital or current accounts of the department to an economic or governmental decision-maker, or from one account to another account.

c. Bond Payments. These include payments on interest and principal of any outstanding capital or current bonds floated by the department.

d. Plant Construction. This includes funds expended for the construction of a new utiltiy plant, the upgrading of an old one, or the demolition of an existing one. Utility plants must be constructed by the Outside System. A UT1 has a fixed construction cost of $30,000,000 and a fixed demolition cost of $6,000,000.

e. Extension of Service. These costs include installation costs for levels of service and redistricting costs. The costs of supplying utility service to a parcel are listed on the following page.

Levels of Service	Installation Costs
1	$2,000,000
2	4,000,000
3	5,000,000
4	6,000,000
5	8,000,000
6	11,000,000
7	1 ,000,000
8	18,000,000
9	28,000,000

There is also a fixed cost of $1,000,000 for redistricting one parcel already being served by a plant to another plant.

f. Land Purchase. This includes expenditures for the purchase of land either from governmental or economic decision-makers or from the Outside System.

O. Utility Department Decisions

In order to provide service and improve its operations, the Utility Department may make any or all of the following decisions during a round of play: purchase land, change level of utility service, transfer cash change prices, and build utility plants.

1. Purchase Land ($PU)

The Utility Department may purchase land from either of two sources: another decision-maker or the Outside System (i.e., the computer). When purchasing land from another decision-maker, the department must buy undeveloped land in portions of 4% of a square mile (i.e., 4, 8, 12, 16 ... 92, 96, 100%) and the terms of the purchase are arrived at by mutual agreement. When bidding on land owned by the Outside System, the department must also purchase land in portions of 4%. The bidding price may be determined from the Fair Market Value map or from other sources available to the department.

2. Change Level of Utility Service ($CVPT)

In response to demands for increased utiltiy service, the Utility Department can install additional levels of service to each parcel in the simulated area or change the utility plant serving a parcel. The costs of installing additional service were explained earlier When installing service, the department must make sure that the new area being served is contingent to a parcel which already has at least one level of service installed by the same plant. There is a fixed cost of $1,000,000 for changing service at a parcel from one utility plant to another.

3. Transfer Cash ($CASH)

The Utility Department may transfer cash between its own capital and current accounts, to the capital or current accounts of other departments or the Chairman, or to an economic decision-maker.

4. Change Prices ($OTHER)

The Utility Department can change the prices which it charges per unit of utility service. The "typical" price of utility service is $10,000 per unit.

5. Build and Demolish Utility Plants ($OUBLD)

The Utility Department may build new plants or upgrade and demolish existing ones. The fixed construction cost of a UT1 is $30,000,000. Construction is completed in the same round that the contract is submitted to the computer.

A utility plant which is serving no parcels may be demolished at a cost of $6,000,000. All parcels which were previously served by such a plant must be allocated to other plants before the computer will accept the demolition. Also, any economic developments on the same parcel as the plant must be demolished before the plant.

P. Bus and Rapid Rail Companies

Although the Bus and Rapid Rail Companies are separate quasi-private departments, they will be treated in the same section due to the similarities between the two. Neither is limited to a single jurisdiction; both have interjurisdictional authority.

The Bus Company and Rapid Rail Company provide additional modes of transportation, (besides automobile) to the population units who live and work in the simulated area. Population units take bus or rail to work only; they do not use either mode of transportation for shopping.

1. Capacity

The Bus and Rapid Rail Companies own rolling stock with three possible levels of service (1, 2, and 3). Level of service indicates the actual number of buses or railroad cars which may serve a particular route.

The number of passengers (capacity that can be effectively served by a rail or bus route) is determined by its level of service. A bus route with a level of service of 1 has a design capacity of 3,000 passengers and a rail route with a level of service of 1 has a design capacity of 6,000 passengers.* Like highways, the design capacity of a bus or rail route is not necessarily its effective capacity. Effective capactiy is determined by multiplying the value ratio of equipment divided by 100 times the design capacity. For example, if the value ratio of equipment for the Bus Company is 85, the effective capacity of a level 2 bus route is 5100. Effective capacity can be further reduced by employment. If the Bus or Rapid Rail Company receives only 75% of the employees which it requested, the actual effective capacity of that route is 75% (i.e., in the previous example .75 x 5100 = 3825).

It must be noted, however, that effective capacity does not refer to the number of people who actually use a bus or rail. A bus or rail route may serve less or more people than its effective capacity. For example, the bus service with an effective capacity of 3825 may actually be used by 6,000 people. In such a case the computer has decided for these people (see "The Employment Process") that, despite the overcrowding, it is still cheaper in terms of time and money to take a bus rather than another mode of transportation.

2. Equipment

The Bus and Rapid Rail Companies do not buy individual pieces of rolling stock. Rather, they purchase units of equipment for each mile of service. One unit of equipment costs $10,000. Forty units of equipment are required to operate a bus (level of service = 1) for one mile and 80 units of equipment are required to operate a rail (level of service = 1) for one mile. Equipment is purchased from the Outside System and its costs are automatically deducted by the computer.

3. Depreciation and Maintenance

Bus and rail equipment which is used depreciates at an average rate of 3.5% per annum. Goods and services for maintenance are automatically purchased from the Outside System (i.e., the computer) at fixed prices. The costs of 1% maintenance or renovation are $40 per equipment unit (goods) and $60 per equipment unit (services).

4. Employment

The Bus and Rail Companies employ workers from middle income population units (PM) only. They obtain their workers through the usual employment process handled by the computer. One PM (160 workers) supplies 1,000 units of labor and 50 units of labor are required to operate a bus (level of service = 1) or rail (level of service = 1) for one mile. One PM of workers therefore serves 20 miles of a BUS1 or RAIL1.

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*Levels of service are multiples of other factors. For example, a rail with three levels of service has a design capacity of 18,000 passengers, three times as much equipment and three times as many employees as a rail at the one level of service.

5. Passenger Assignments

Passengers are assigned to travel to work by bus and/or rail by the computer. The basis upon which a population unit may or may not be assigned to bus or rail transportation is the dollar value of their time. This value is assigned by social decision-makers. The normal dollar value of a time unit (based on typical salaries of $2,500 per low income (PL) worker, $5,000 per middle income (PM) worker, and $10,000 per high income (PH) worker is $25 for a PL, $50 for a PM and $100 for a PH.

Those population units with the lowest dollar value of time will take the cheapest but probably the longest route of transportation to work. Those population units with a high dollar value of time will take a more expensive but quicker mode of transportation to work.

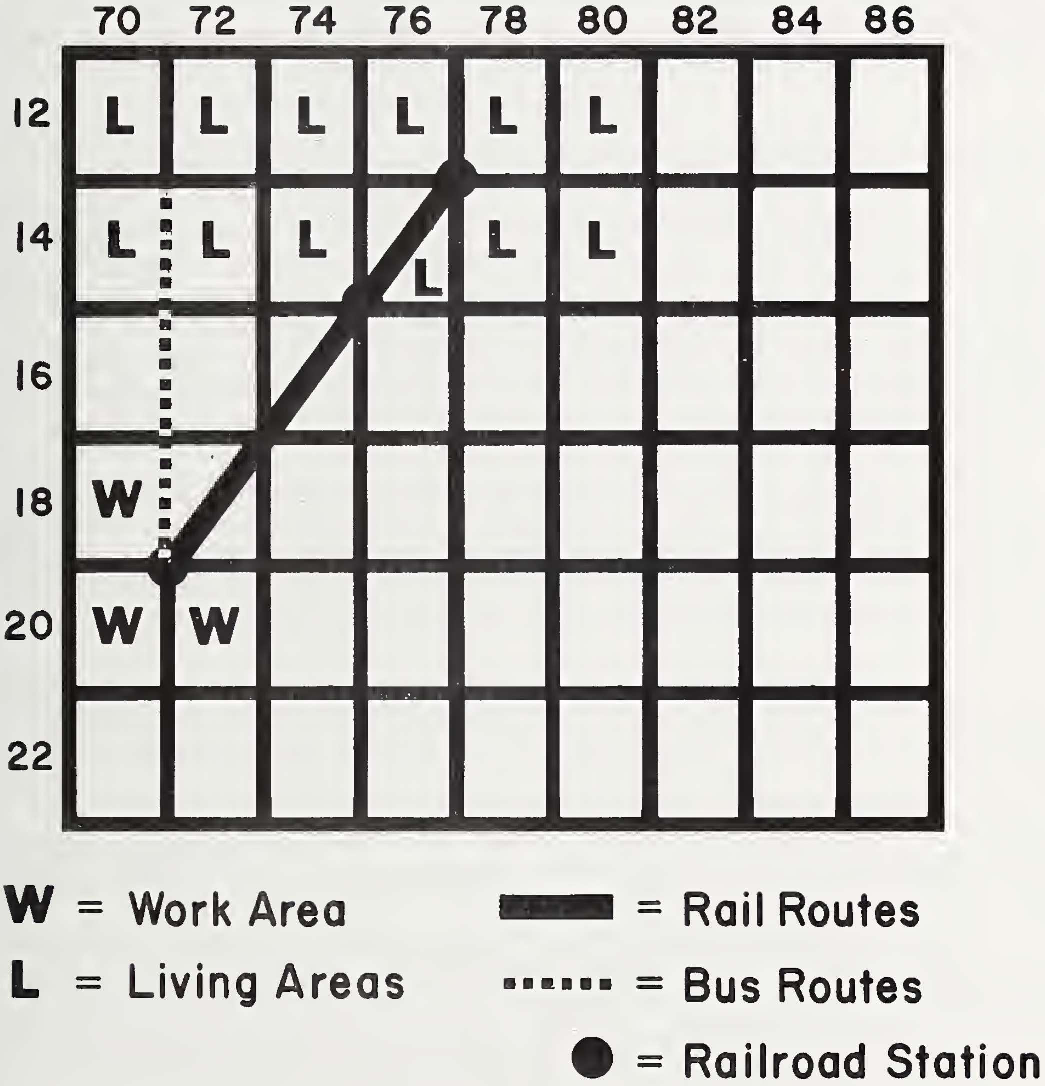
The following example will demonstrate how the computer considers the dollar value of time. Let us say the transportation costs of a population unit are $150 per year to get to work by bus and by auto. It also requires an extra 4 time units to travel by bus instead of auto. If the dollar value of time for that population unit was set at $40, it would cost them $150 plus 4 units times $40 (dollar value) or $310 to get to work by bus. To take auto, it costs $320 (no extra time units consumed). Therefore, the computer would assign the population unit the bus mode to travel to work (i.e., $310 < $320).

In the same case, suppose the dollar value of time was set to $50. Then, the total bus cost would be $150 plus 4 time units times $50 (dollar value) or $350. Auto would cost only $320. Therefore, the computer would assign these population units the auto mode to work (i.e., $320 < $350).

6. Routes

Buses travel along roads and trains go along tracks. The Bus Company must therefore specify routes only on existing highways, while the Rail Department can have routes wherever they build tracks, including on the diagonal across parcels and either overground or underground. Routes must begin and end at intersections. Further, although bus and rail transport workers to and from their place of employment, the direction of the route is specified in order to meet residence to work demands. For example, assume that people live in the parcels above the line 15 and that most employment locations are at parcels 7018, 7020 and 7220.

The routes that should be specified are the morning routes that bring people to work. In this instance they are 7113 to 7119 (for bus) and 7713 to 7119 (for rail). A bus stops at every intersection but a rail will stop only where there are stations and there can only be stations at intersections. In the example (page 90) therefore, the rail has three stops: 7713, 7515, and 7119. In planning routes decision-makers for bus and rail will often discover that a key element involves the proximity of stops to parcels where the greatest number of people work and/or live.


70 72 74 76 78 80 82 84 86
12 L L L L L L
14 L L L L L L
16
18 W
20 W W
22
W = Work Area
L = Living Areas
= Rail Routes
= Bus Routes
= Railroad Station

7. Land Requirements

Although buses do not require land (they operate on highways), surface rail tracks require 4% of land (on either side) per mile. In the case of a diagonal track, it requires 4% of the land from each parcel which it crosses. All land must be purchased by the company prior to the construction of tracks. Underground rail tracks do not require land.

8. Revenues

Like the Utility Department, the Bus and Rapid Rail Companies are quasi-private departments and therefore do not receive direct appropriations from the Chairman. Both companies, however, can receive income from any of the following sources:

a. Subsidies. These are public subsidies granted by the Chairman to the current or capital accounts of either company.

b. Bonds. Current bonds are automatically floated by the computer if the current expenditures of either company exceed current revenues. Current bonds have a duration of two years and the interest rate is set by the computer. Capital bonds may be floated for either company by the Chairman subject to a referendum by the social sector. Capital bonds have a duration of 25 years and the interest rate is determined by the computer.

c. Fares. The primary source of income for the Bus Company and Rail Company is the fares which they charge to passengers who use their service. Fares are deducted by the computer from the accounts of population units represented by social decision-makers on the basis of 250 trips to work and 250 trips from work each year (round).

d. Miscellaneous. These revenues include such items as cash transfers to the capital or current accounts of either company and income from the sale of land (capital account of Rail Company only).

9. Expenditures

The Bus and the Rail Companies spend money on the following items:

a. Vehicle Maintenance. This includes the cost of maintenance and renovation costs of vehicles owned by the companies. It involves purchases of goods and services at fixed prices from the Outside System (i.e., the computer). The costs of 1% renovation or maintenance are $40 (goods) and $60 (services) per equipment unit.

b. Salaries. Since both companies hire middle income (PM) workers, they must offer competitive salaries. The "typical" salary per PM worker is $5,000. There are 160 workers in a PM.

c. *Bond Payments*. These include payments on interest and principal of any outstanding capital or current bonds floated by either company.

d. *Miscellaneous*. These expenditures include cash transfers from the capital or current accounts of the company to an economic or governmental decision-maker, or from one account to another account.

e. *Vehicle Purchase*. This is a capital expenditure for the purchase of rolling stock. One unit of equipment (either bus or rail) has a fixed cost of $10,000. If any stock is sold, this item will subtract the selling price of stock and may indicate a negative number which will be credited to the capital account of the company. The selling price of a unit of equipment is defined as: .50 times value ratio of equipment/100 times $10,000.

f. *Station Construction*. (Rail Company only). This includes expenditures for building stations. All stations are built by the Outside System and have a fixed construction cost of $1,000,000 and a demolition cost of $200,000.

g. *Track Construction*. (Rail Company only). This includes expenditures for the construction or upgrading of rail tracks. All tracks are built by the Outside System and have a fixed construction cost of $4,000,000 per mile (surface tracks) and $14,000,000 per mile (underground tracks). Demolition costs are $800,000 per mile (surface tracks) and $2,800,000 per mile (underground tracks). The cost of diagonal tracks is a function of the hypotenuse of the triangle formed by the rail segment. This relationship is explained below:

Distance for Diagonal Rapid Rail Segments

		Horizontal Distance Between Stations				
		1	2	3	4	5
Vertical distance between stations	1	1.414	2.236	3.162	4.123	5.090
	2	2.236	2.828	3.606	4.472	5.385
	3	3.162	3.606	4.243	5.000	5.831
	4	4.123	4.472	5.000	5.657	6.403
	5	5.099	5.385	5.831	6.403	7.071

In other words, a segment of surface track crossing a single (one square mile) parcel diagonally does not cost $4,000,000, but 1.414 times 4,000,000 or $5,656,000.

h. *Land Purchase*. (Rail Company only). This item includes expenditures for land purchased from the governmental or economic sectors or from the Outside System (i.e., the computer).

Q. Bus and Rapid Rail Company Decisions

In order to operate efficient modes of transportation, the Bus and Rail Companies may make any or all of the following decisions during a round of play: change level of service, change routes, transfer cash, purchase or sell stock, set fares, change salary, change maintenance level, purchase land and build rail lines and stations.

1. Change Level of Service ($ROUT)

The Bus and Rail Company may increase or decrease the level of service on a particular route. There are three possible levels of service for each mode of transportation. The design capacity (i.e., number of passengers that can be served) of each level of service is:

Level of Service	Design Capacity (Passengers)	
	Bus	Rail
1	3,000	6,000
2	6,000	12,000
3	9,000	18,000

When changing levels of service, the Bus and Railroad Companies should make sure that they have purchased sufficient equipment for servicing the routes. The equipment requirements are:

Level of Service	Equipment Requirements (Units)	
	Bus	Rail
1	40 per mile	80 per mile
2	80 per mile	160 per mile
3	120 per mile	240 per mile

(Note: The Bus Company can form a new route merely by adding at least 1 level of service to a previously non-existent route. The Railroad Company, however, must purchase land and construct tracks in order to form a new route.)

2. Purchase or Sell Rolling Stock ($OTHER)

The Bus and Rail departments may purchase new units of equipment or sell old equipment. One equipment unit costs $10,000. The price received for used equipment (sold to the Outside System) is defined as: .50 times value ratio of equipment/100 times $10,000.

3. Set Fares ($OTHER)

The Bus and Rail Companies may set the base and per miles fares to be paid by passengers. Fares are automatically collected from the accounts of population units represented as social decision-makers by the computer. Fares are computed on the basis of 250 trips to work and 250 trips from work per year (round).

4. Change Salary ($OTHER)

The Bus and Rail Company may specify the salary to be paid to its middle income (PM) workers. The typical salary per PM worker is $5,000. There are 160 workers in a PM.

5. Change Maintenance Level ($OTHER)

In order to counter depreciation, the Bus and Rail Companies may specify the level at which the average value ratio of rolling stock is to be maintained. Maintenance involves purchases of goods and services from the Outside System at fixed costs of $40 (goods) and $60 (services) per equipment unit per 1% maintenance.

6. Transfer Cash ($CASH)

The Bus and Rail Companies may transfer cash between their own capital and current accounts, to the capital or current account of another department, or to an economic decision-maker.

7. Purchase Land ($PU)

The Rail Company only purchased land. Land may be purchased from another decision-maker or from the Outside System. A rail requires 4% of a square mile (from either side) for surface tracks, regardless of the level of service.

8. Build Rail Lines and Stations ($RAIL)

The Rail Company may construct rail lines or stations. The fixed costs of a rail line are $14,000,000 per mile for underground and $4,000,000 per mile for surface tracks. A station costs $1,000,000. All construction costs are paid to the Outside System. Tracks and stations may not be demolished.

VI. COMPUTER OUTPUT

The computer output is one of the most important components of the City Model operation. It portrays the economic, social and government status of the simulated area at a given point in time. Players make decisions and feed them to the computer. New output is printed which describes the changes that have occurred.

Since all output contains a lot of numbers, it is most important that participants understand the numerical parameters in the City Model. These numbers are discussed in the chapters for each sector and summarized in the Master Sheets (Chapter VII). It is recommended that participants refer often to the Master Sheets when analyzing their output.

There are two types of output in the City Model. General output, Sections A through F, is for use by all participants; it is important to all three sectors. All other output is distributed to a particular decision-maker in the economic, social or governmental sector. Furthermore, the decision-maker for which this output is intended is identified on the heading of the output.

An explanation and samples of the output for the various sectors follow:

A. Status Maps

1. Economic Status Map (Figure 1)

This map shows all of the roads and terminals and at most five things for all privately owned parcels of land:

a. Ownership - which economic decision-maker owns a particular parcel. (Upper left hand corner)

b. Zoning - the zoning classification of a particular parcel. (Upper right hand corner)

The zoning codes (set by the Planning and Zoning Department) are:

Land Use	Code
Any Use	00
Any Business (includes HI, LI, NS, CI, BG, BS, PG, PS)	10
Any Manufacturing	20
HI	21
LI	22
CI	23

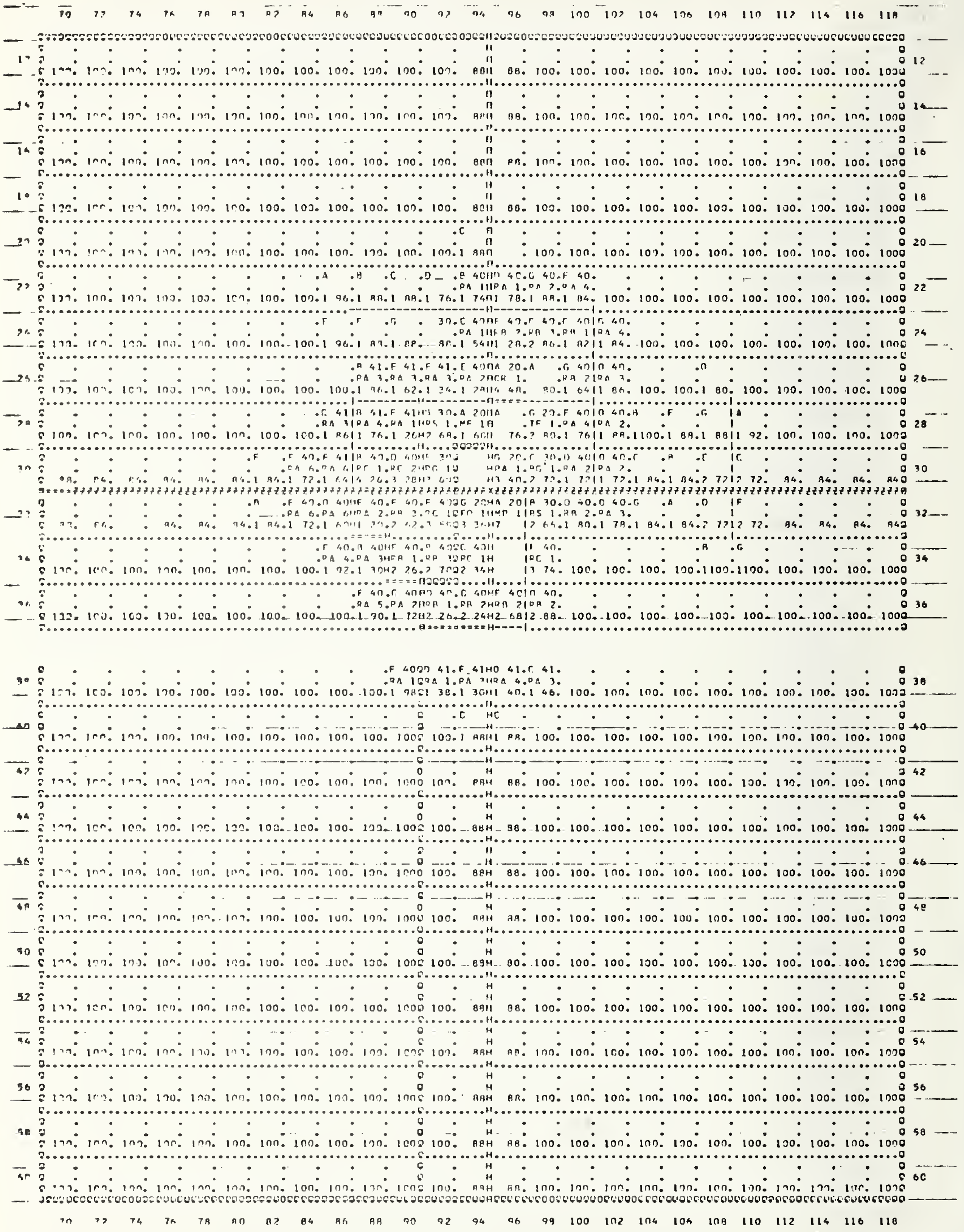
The zoning codes set by the Planning and Zoning Department continue below:

Land Use	Code
Any Non-manufacturing	30
NS	31
BG	32
BS	33
PG	34
PS	35
Any Residential	40
RA	41
RB	42
RC	43
Parkland	50

HI includes FL, SG, MP, MF, NL, EL, TE
LI includes FO, TA, PA, CR

```
TWO CITY--HOWARD UNIVERSITY URBAN SYSTEMS ENGINEERING PROGRAM.
[illegible]                                                                    ROUND  1
```

FIGURE 1



```
       PARCEL KEY                         PARCEL EDGES                    INTERSECTIONS          ZONING  LAND USE       ZONING  USE
TOP LEFT:      OWNER                 .. .. BOARDED                   + TYPE 1 TERMINAL       --     ANY USE              33   RS
TOP RIGHT:     ZONING                -- II TYPE 1 ROAD               X TYPE 2 TERMINAL       10     ANY BUSINESS         34   PG
MIDDLE:        LAND USE AND LEVEL    == HH TYPE 2 ROAD               * TYPE 3 TERMINAL       20     HI,LI,CI             35   PS
BOTTOM LEFT:   UTILITY LEVEL         ZZ WW TYPE 3 ROAD                                       21     HI                   40   RA,RB,RC
BOTTOM RIGHT:  % UNDEVLPD LAND       CO 00 JURISDICTION BOUNDARY                             22     LI                   41   RA
                                                                                             23     CI                   42   RB
                                                                                             30     NS,RG,RS,PG,PS       43   RC
                                                                                             31     NS                   50   PARKLAND
```

c. Land Use Type and Level of Development - the kind of land use which exists on a particular parcel and its level of development (Center).

There are eleven economic uses. They are:

Basic Industry	
HI	Heavy Industry: FL - Furniture and Lumber SG - Stone, Clay and Glass MP - Primary Metals MF - Fabricated Metals NL - Nonelectric Machinery EL - Electric Machinery TE - Transportation Equipment
LI	Light Industry FO - Food TA - Textiles and Apparel PA - Paper CR - Chemicals, Plastics and Rubber
NS	National Services: insurance, consulting, etc.
Construction Industry	
CI	Construction: building upgrading, demolition
Commercial Establishments	
BG	Business Goods: intermediate products, raw materials, etc.
BS	Business Services: computer, accounting, legal, etc.
PG	Personal Goods: food, drugs, appliances, etc.
PS	Personal Services: banking, restaurants, etc.
Residences	
RA	Single family housing
RB	Townhouses, garden apartments
RC	Highrise apartment buildings

Development level ranges from 1 to h for all uses. The integer number, h, is the ratio of the total. Percent of land available for development (usually 100%) to the percent of land required for one level of development of a particular land use. Development level indicates the size of the building and is a multiplier which determines capacity, land requirements, employment requirements, etc.

d. Percent of Undeveloped Land - the amount of land which is privately owned but undeveloped on a given parcel. (Lower right hand corner.)

All economic land uses require a percentage of the parcel for development. The land requirements of economic land uses at the first level of development are:

Land Use	% of Square Mile
FL1	28
SG1	40
MP1	48
MF1	20
NL1	15
EL1	12
TE1	12
FO1	20
TA1	6
PA1	16
CR1	28
NS1	12
CI1	20
BG1	12
BS1	20
PG1	10
PS1	12
RA1	2
RB1	2
RC1	2

If an economic decision-maker does not own 100% of a parcel, it is because there may be government land uses on that parcel (i.e., a road, utility plant, school, municipal service plant, terminal, parkland) or the land may be preempted from local use. To determine the location of government land uses, see Government Status Map. Preempted land is shown on Preempted Land Map.

Land uses at other levels of development require land in direct proportion to the level. For example, an FL2 requires 56% of a square mile, and an RB6 requires 12% of a square mile.

e. Level of Utility Service - the level of utility service made available by the utility plant serving that parcel. (Lower left hand corner.)

The utility requirements for the various economic land uses (at the first level of development) are:

Land Use	Utility Units Required	Minimum Level of Service
FL1	50	1
SG1	100	1
MP1	700	7
MF1	100	1
NL1	100	1
EL1	200	2
TE1	200	2
FO1	300	3
TA1	100	1
PA1	300	3
CR1	400	4
NS	76	1
BG1	112	2
BS1	71	1
PG1	99	1
PS1	77	1
RA1	4	1
RB1	26	1
RC1	117	2

2. Government Status Map (Figure 2)

This map shows the location of the following government land uses:

a. Schools - the location and development level of all schools. (Indicated by "S" in upper right corner).

b. Percent of Parcel in Parkland - the location and amount of all parkland. The amount of parkland is given in percentages of the square mile parcel. (indicated by number in center).

c. Utility Plant - the location and level of development of all utility plants. (Indicated by "U" in the lower right corner.)

d. Municipal Services Plants - the location and development level of all MS plants. (Indicated by "M" in the lower left corner.)

3. Social Decision-Maker Map (Figure 3a)

a. Social Decision-Maker Map - indicates which social players make decisions for the low, middle, and high income population units on parcels. The top letter on a given parcel represents the social decision-makers for that parcel appear on this map.

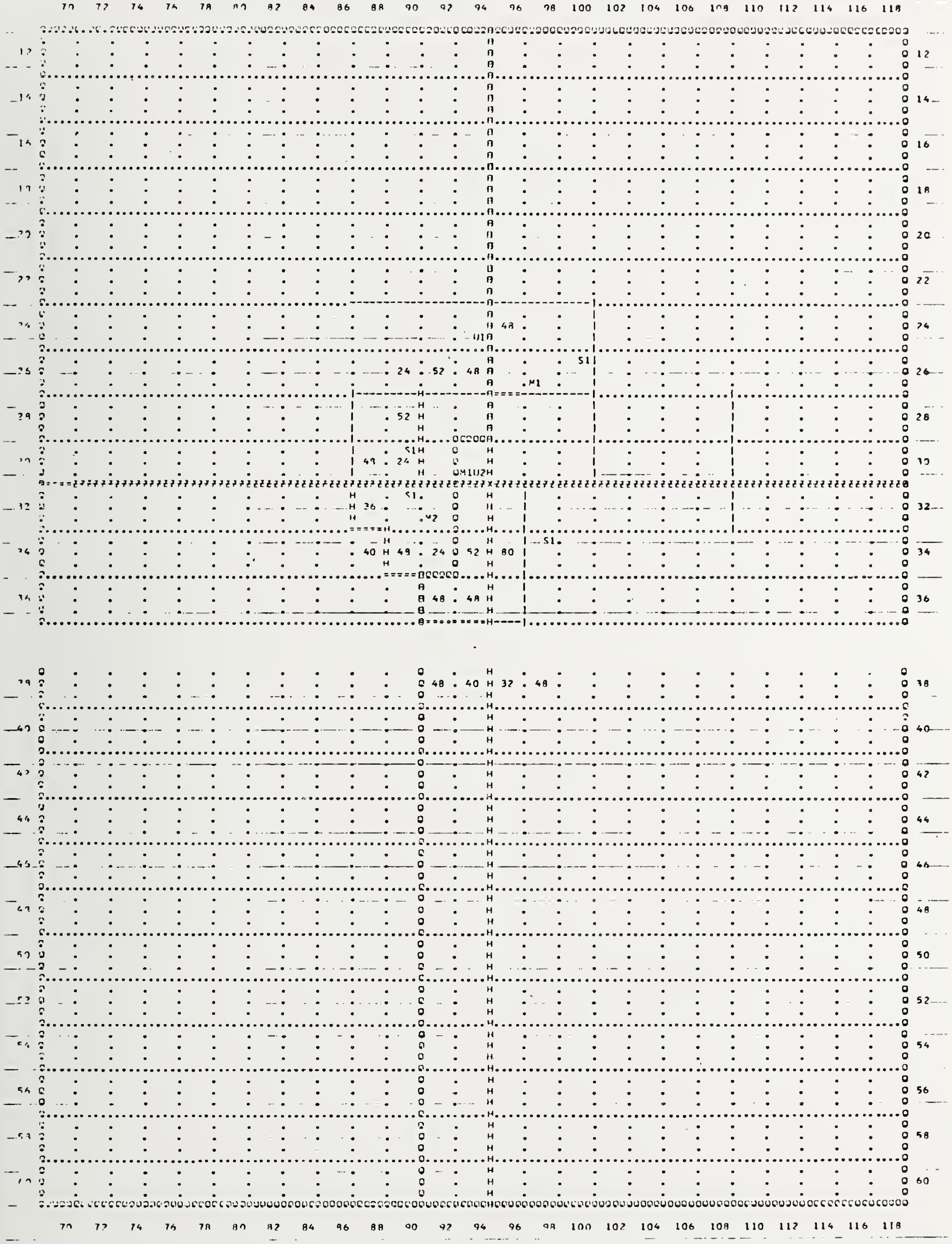
b. Socio-Economic Distribution Map (Figure 3b)- this map relates the economic activity of residence to population distribution. It provides the user with residence types and levels, number of Pl's of each clan, road types terminal levels and jurisdiction boundaries. The migration process allocates people to housing and the population density that results is shown in Figure 5, the Demographic Map.

4. Topographical Restriction Map (Figure 4)

This map shows the percent of a parcel that may not be purchased or developed by any local decision-makers. Land that is topographically undevelopable includes mountains, rock outcrops, and swamps. None of the area consumed by water bodies represented in the local system (lakes and rivers) is shown on this map. The map also shows jurisdictional boundaries, the road network and the location of terminals.

```
TWO CITY--HOWARD UNIVERSITY URBAN SYSTEMS ENGINEERING PROGRAM.
GOVERNMENT STATUS MAP                                   ROUND  1
```

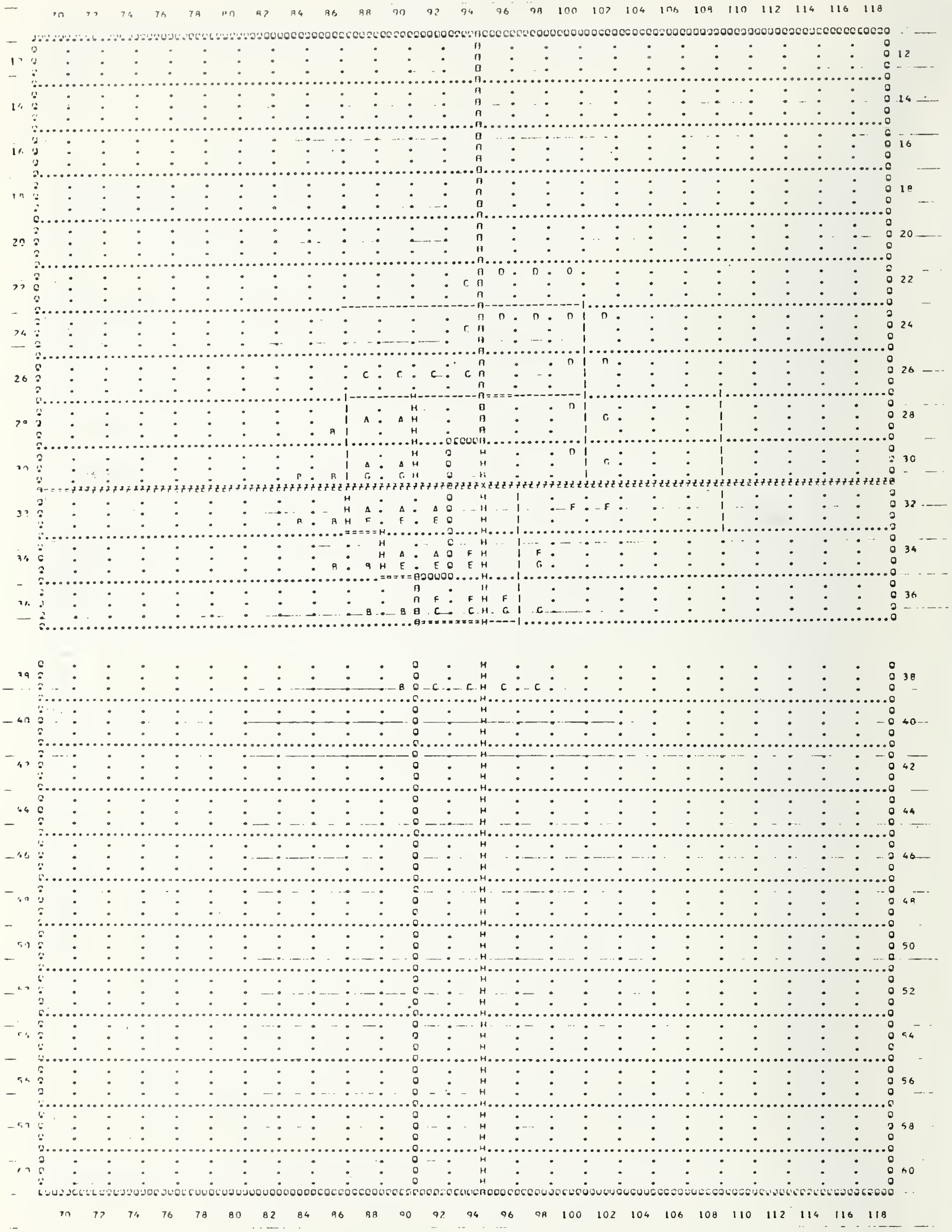
FIGURE 2



```
        PARCEL KEY                      PARCEL EDGES                INTERSECTIONS
 TOP RIGHT:     SCHOOL + LEVEL       .. .. ROADBED                 + TYPE 1 TERMINAL
 MIDDLE ROW:    % UNDV PRKLND        -- || TYPE 1 ROAD             X TYPE 2 TERMINAL
 BOTTOM LEFT:   HS UNIT + LEVEL      == HH TYPE 2 ROAD             * TYPE 3 TERMINAL
 BOTTOM RIGHT:  UT PLANT + LVL       ZZ ## TYPE 3 ROAD.
                                     OO OO JURISDICTION BOUNDARY
```

```
TWO CITY--HOWARD UNIVERSITY URBAN SYSTEMS ENGINEERING PROGRAM.
SOCIAL DECISION MAKER MAP                                              ROUND  1
```

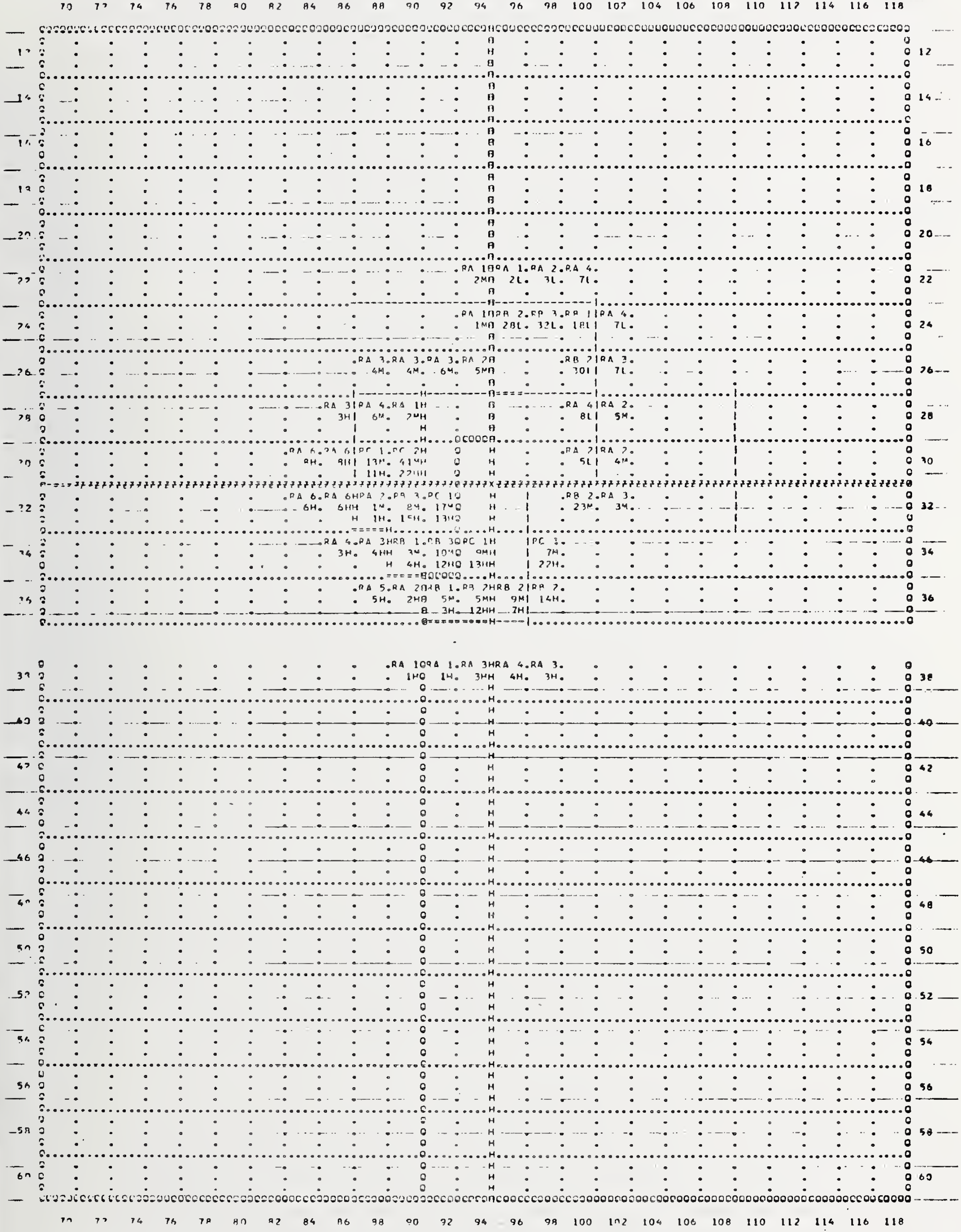
FIGURE 3a



```
        PARCEL KEY                       PARCEL EDGES                  INTERSECTIONS
TOP ROW:    LOW SOC D-M              .. .. ROADBED                   + TYPE 1 TERMINAL
MIDDLE ROW: MID SOC D-M              -- || TYPE 1 ROAD               X TYPE 2 TERMINAL
BOTTOM ROW: HI SOC D-M               == HH TYPE 2 ROAD               * TYPE 3 TERMINAL
                                     ZZ HH TYPE 3 ROAD
                                     OO OO JURISDICTION BOUNDARY
```

```
TWO CITY--HOWARD UNIVERSITY URBAN SYSTEMS ENGINEERING PROGRAM.
                    SOCIO-ECONOMIC DISTRIBUTION MAP                              ROUND  1
```

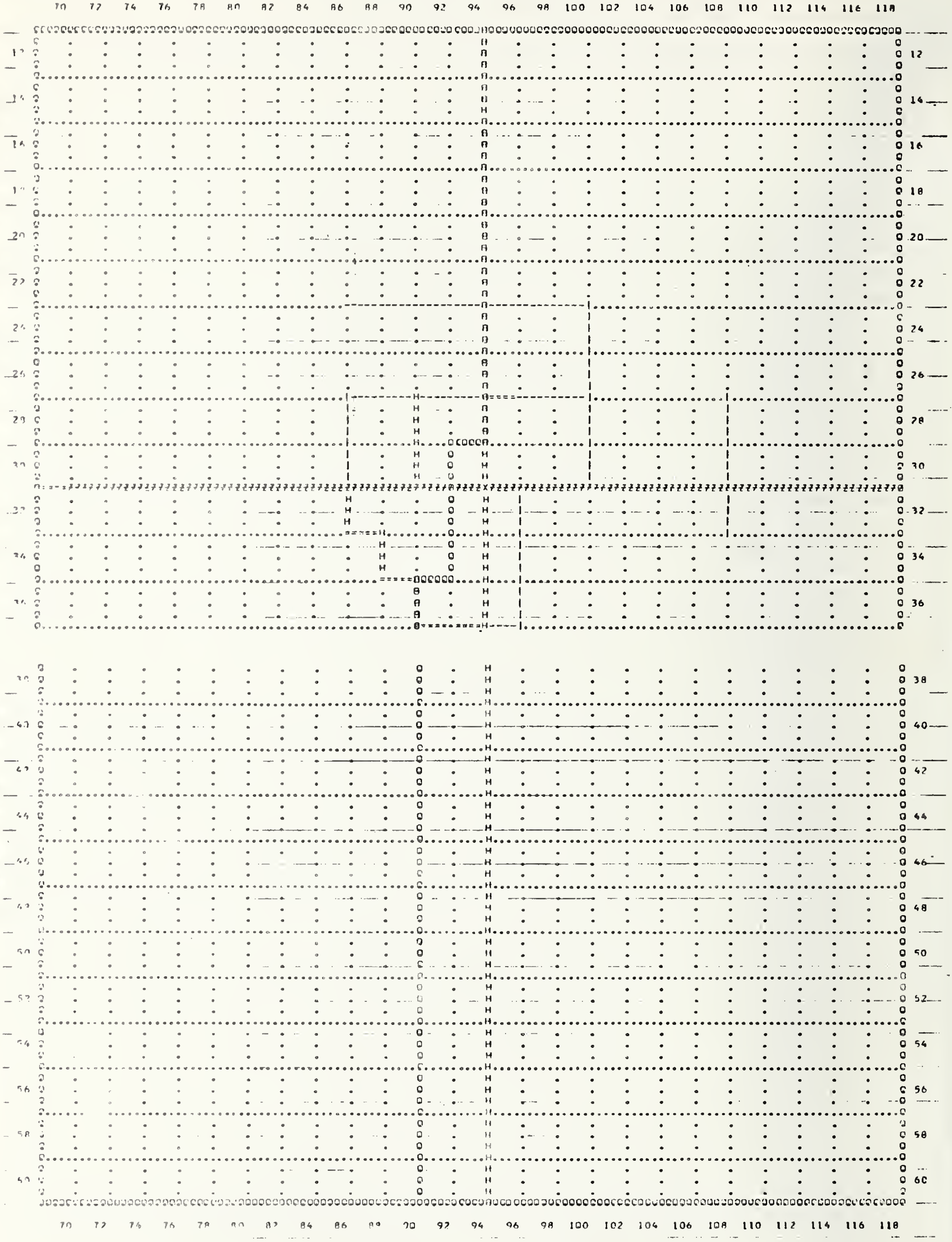
FIGURE 3b



```
        PARCEL KEY                                PARCEL EDGES                INTERSECTIONS
  TOP ROW:      RESIDENCE TYPE AND LEVEL    .. ..  ROADBED                    + TYPE 1 TERMINAL
  MIDDLE ROW:  NUMBER OF RI*S AND CLASS    -- ||  TYPE 1 ROAD                X TYPE 2 TERMINAL
  BOTTOM ROW:  NUMBER OF RI*S AND CLASS    == HH  TYPE 2 ROAD                * TYPE 3 TERMINAL
                                            ZZ MM  TYPE 3 ROAD
                                            OO OO  JURISDICTION BOUNDARY
```

```
TWO CITY--HOWARD UNIVERSITY URBAN SYSTEMS ENGINEERING PROGRAM.
TOPOGRAPHICAL RESTRICTION MAP                                    RECORD 1
```

FIGURE 4



```
KEY                         PARCEL EDGES                      INTERSECTIONS
                            .. ..                             TYPE 1
                            -- || TYPE 1 ROAD                 TYPE 2
                            ==    TYPE 2 ROAD               • TYPE 3
                            ZZ    TYPE 3 ROAD
                            OO OO JURISDICTION BOUNDARY
```

5. Demographic Map (See Figure 5)

This map shows the population (scaled in 100's) on each residential parcel in the simulated area and its percent occupancy. The quality index of a residence and the value ratio of a business are shown after depreciation but before maintenance is performed.

B. Land and Building Value Maps

1. Auction Asking Price Map (Figure 6)

Economic and government teams may purchase or attempt to purchase land that is presently unowned (actually it is owned by small farmers and outside-the-system landowners whose interests are represented by the computer).

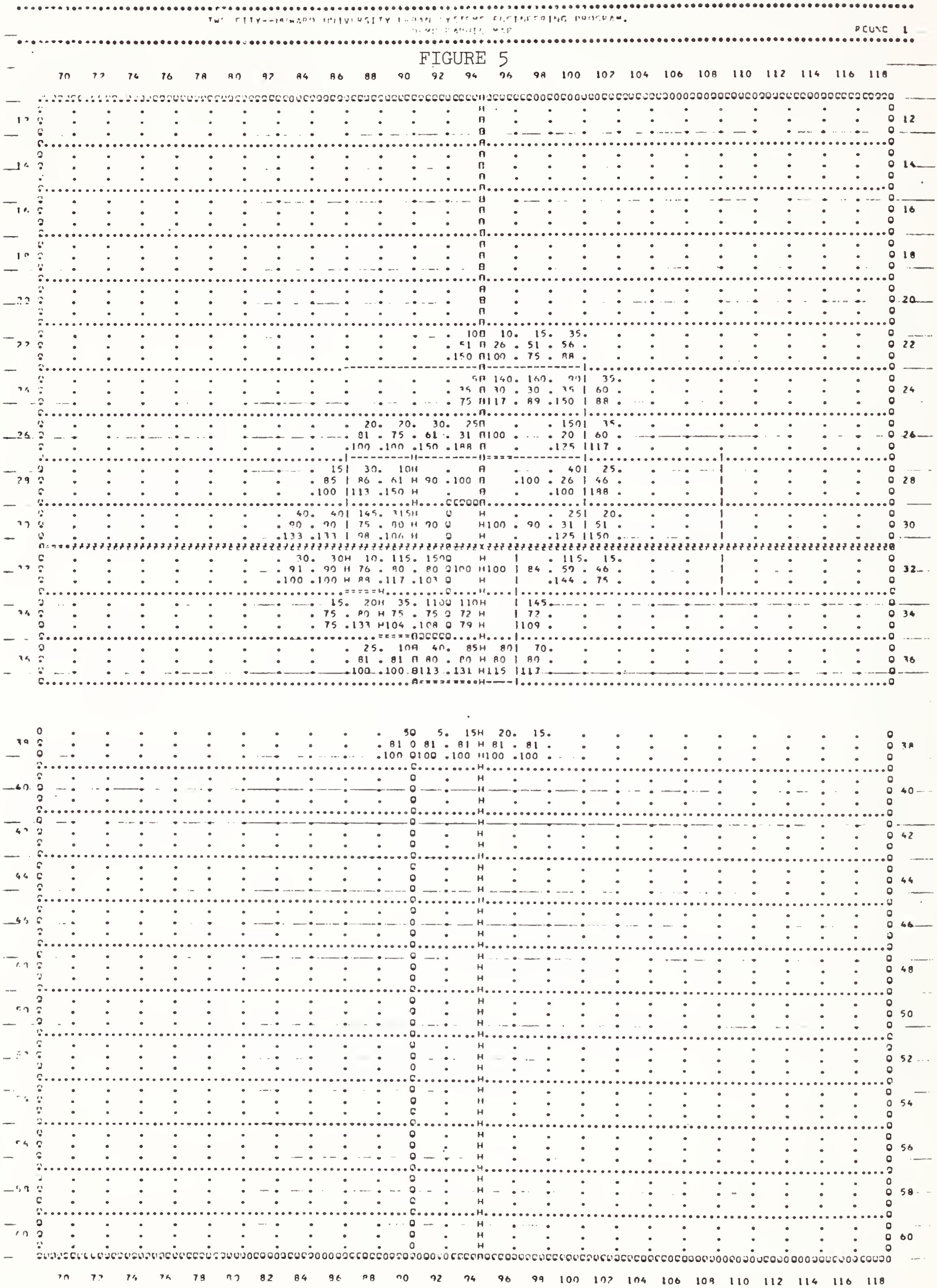
Teams may attempt to purchase land that is up for auction or make an unsolicited bid for an unowned parcel. Economic teams must purchase all the land on an unowned parcel that is not already owned by a government department or consumed by topographical constraints. Government departments (SC, MS, UT, HY, RAIL, and PZ) may purchase or attempt to purchase any amount of the unowned and unconstrained land that they wish in multiples of 4%. All private and public bids on unowned land cost the bidder 2% of the offered price, whether the bid is successful or not.

Each round a number of parcels of unowned land are auctioned by the computer. The Auction Asking Price Map shows the market value of those parcels (in $1,000's). Each bid for an auctioned parcel of land is assigned a probability of success according to the curve in the figure below. Note that a bid that is 62% or more than the auction asking price has a 100% chance of being accepted. If several teams bid more than 62% of the asking price, but less than 100% of the asking price, the highest bid wins. In fact, all bids that are less than 100% of the asking price are considered by the computer in order of the highest bids first. If there are one or more bids that are 100% or more of the auction asking price, then the first bid submitted to the computer purchases the land.

2. Market Value Map (Figure 7)

The value of outside-owned parcels not up for auction can be estimated from the Market Value Map and the Auction Asking Price Listing. The Market Value Map shows the total value (100%) of parcels owned by economic decision-makers. The value of an unowned parcel is affected by the value of surrounding parcels, the availability of roads, whether the parcel has utilities, and what the parcel's zoning classification is.

FIGURE 5



PARCEL KEY
TOP ROW: TOTAL POP IN 100'S (RES)
MIDDLE ROW: DU (RES) OR VP (NR)
BOTTOM ROW: % OCCUPANCY (RES)

PARCEL EDGES
.. .. BOARDED
-- II TYPE 1 ROAD
== HH TYPE 2 ROAD
TYPE 3 ROAD
OO OO JURISDICTION BOUNDARY

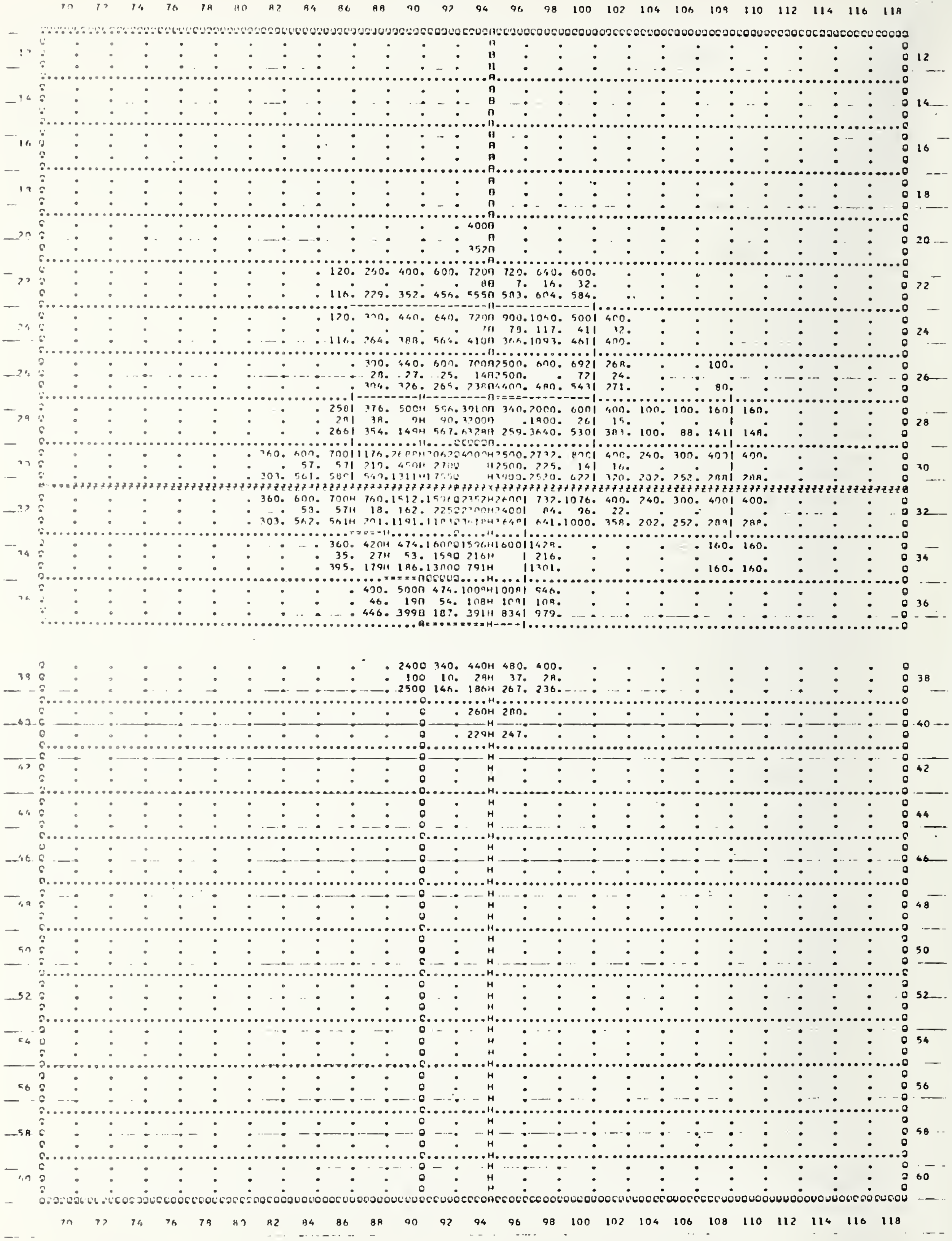
INTERSECTIONS
• TYPE 1 TERMINAL
X TYPE 2 TERMINAL
• TYPE 3 TERMINAL

FIGURE 6

```
..................................................................
                              BLUECITY
                             AUCTION ASKING PRICE MAP        (IN $1,000'S)
..................................................................
       70    72    74    76    78    80    82    84    86    88    90    92    94
..................................................................
12  .   0     0     0     0     0     0     0     0     0     0     0     0     0
    .
14  .   0     0     0     0     0     0     0     0     0     0     0     0     0
    .
16  .   0     0     0     0     0     0     0     0     0     0     0     0     0
    .
18  .   0     0     0     0  1502     0     0     0     0     0     0     0     0
    .
20  .   0     0     0     0     0     0     0     0     0     0     0     0     0
    .
22  .   0     0     0     0     0     0     0     0     0     0     0     0     0
    .
24  .   0     0     0     0     0     0     0     0     0     0     0     0     0
    .
26  .   0     0     0     0     0     0     0     0     0     0     0     0     0
    .
28  .   0     0     0     0     0     0     0     0     0     0     0     0     0
    .
30  .   0     0  1908     0     0     0     0     0     0     0     0     0     0
    .
32  .   0     0     0     0     0     0     0     0     0     0     0     0     0
    .
34  .   0     0     0     0     0     0     0     0     0     0     0     0     0
    .
36  .   0     0     0     0     0     0     0     0     0     0     0     0     0
    .
38  .   0     0     0     0     0     0     0     0     0  4028     0     0     0
    .
40  .   0     0     0     0     0     0     0     0     0     0     0     0     0
    .
42  .   0     0     0     0     0     0     0     0     0     0     0     0     0
    .
44  .   0     0     0     0     0     0     0     0     0     0     0     0     0
```

TWO CITY--HOWARD UNIVERSITY URBAN SYSTEMS ENGINEERING PROGRAM.
MARKET VALUE MAP
ROUND 1

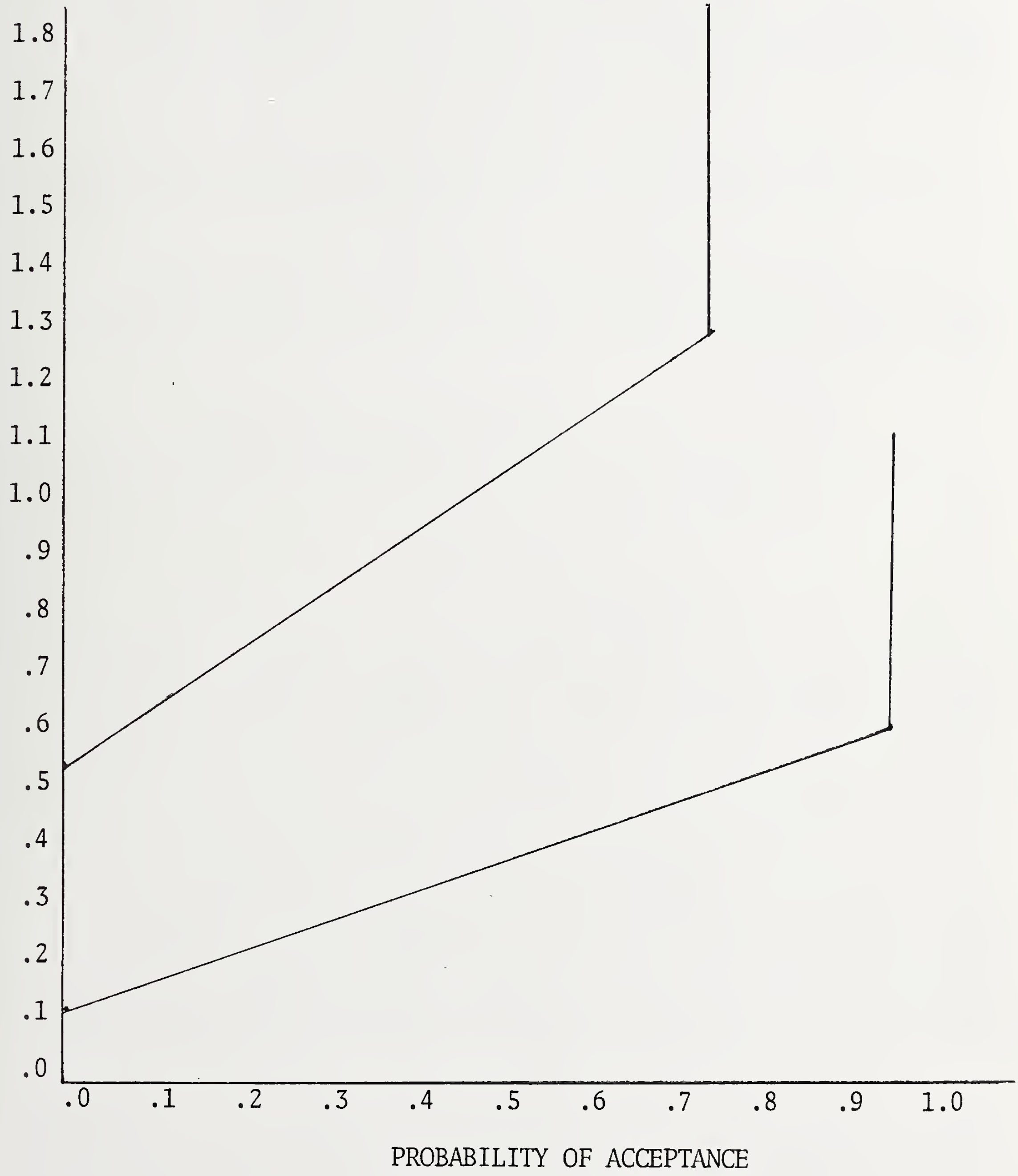
FIGURE 7



```
        PARCEL KEY                               PARCEL EDGES                INTERSECTIONS
TOP ROW:    MKT VALUE OF 100% OF LAND       .. .. ROADBED                • TYPE 1 TERMINAL
MIDDLE ROW: MKT VALUE OF PRIV BLDGS         -- || TYPE 1 ROAD           XTYPE 2 TERMINAL
BOTTOM ROW: MKT VAL OF PRIV LAND & BLDGS    == HH TYPE 2 ROAD           • TYPE 3 TERMINAL
        ALL VALUES IN $100,000'S            ZZ NN TYPE 3 ROAD
                                            OO OO JURISDICTION BOUNDARY
```

Teams may make as many unsolicited bids as they wish in a round. Each unsolicited bid is assigned a probability of success according to the appropriate curve in the figure above. Note that no unsolicited bid can have more than a 90% chance of success despite the amount of the bid. Note also that when an unsolicited bid is equal to the market value of a parcel, there is a 50% chance of success.

RELATION BETWEEN THE PROBABILITY OF ACCEPTANCE AND THE RATIO OF BID TO ASKING PRICE



Besides jurisdictions and highway systems this map displays the non-farm parcels of land that are owned by local decision-makers, with the market value information.

The top row of each parcel indicates the market value, for 100% of the land. This value allows comparisons to be made from one parcel to another without having to take into consideration what percentage of each parcel is privately owned. Since there is usually a small percent of public land on each parcel the actual market value is less.

The middle number is the value of the development on each parcel. The bottom number is the value of the privately owned land plus the development value on the land.

3. Assessed Value Map (Figure 8)

This map provides the assessed value of non-farm land in much the same manner that the Market-Value Map presented it.

Top number is the assessed land value for 100% of land, middle is the assessed value of the development i.e. the building itself and the bottom number is total assessed value of privately owned land and building.

4. Farm Assessed and Market Value Map (Figure 9a)

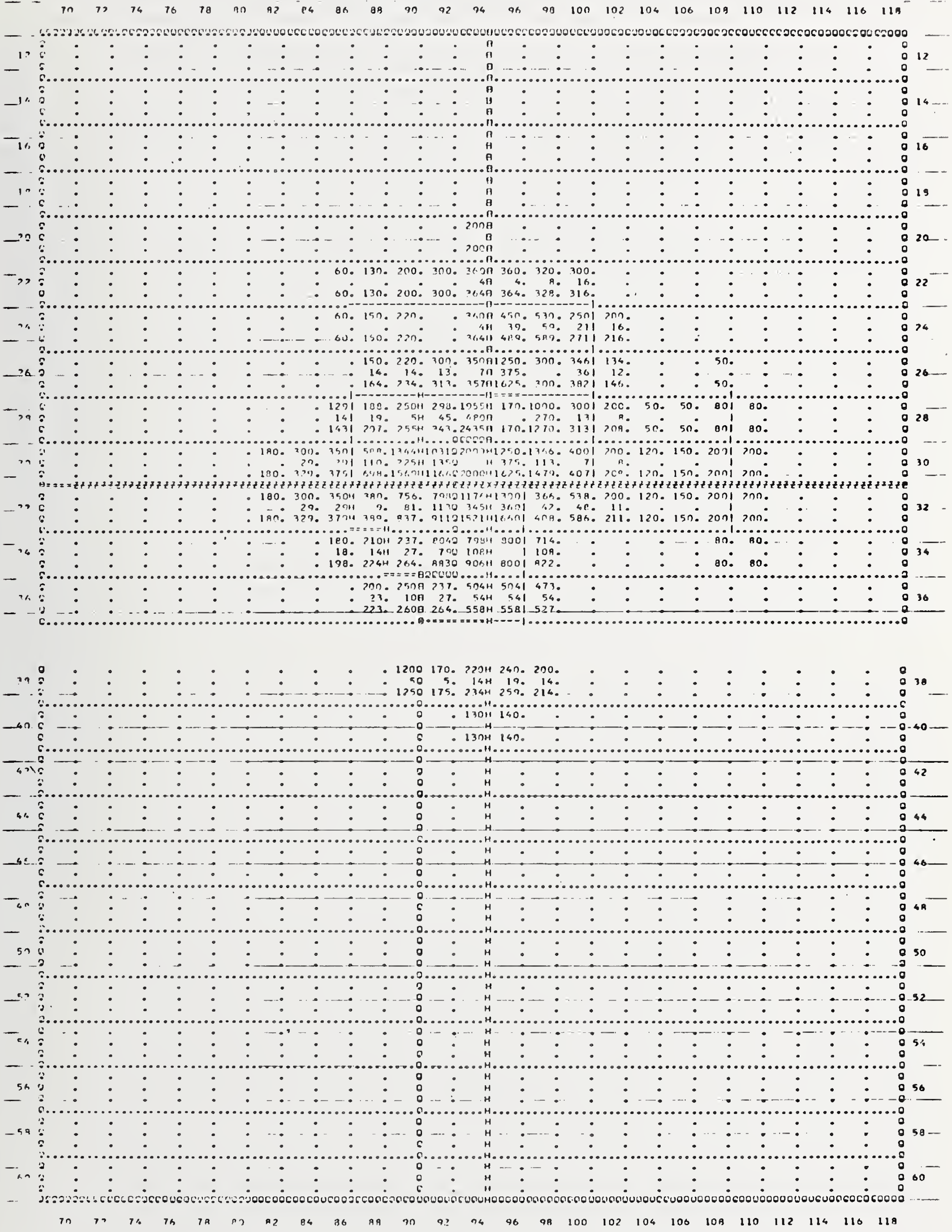
This map presents the assessed value of the farmland in the top number, the market value of the farmland and the percent of the parcel in farmland in the bottom number.

5. Farm Map (Figure 9b)

A farm can contain more than one parcel. All of the parcels belong to one owner. The map displays the owner, farm code number, farm type, and fertilizer level. The amount of land in farm use depends on the amount of land in government use or topographically unusable. Since farming is an economic activity as other economic activity could take place on a farm parcel. A farm does not have to be demolished and in fact when the land used for a farm changes ownership, the farm activity automatically ceases, and it is up to the new owner to reclassify the land as farm or change it to a new economic activity. A farmer can make only two types of decisions, a) set the fertilizer level for a farm and b) sell all or part of the farmland. By setting the fertilizer level the farmer may change the farm yield. The levels are integer from 0 to 3. Coupled with the increased yield is the increase in pollution in the water runoff resulting from each fertilizer factor.

```
                    TWO CITY--HOWARD UNIVERSITY URBAN SYSTEMS ENGINEERING PROGRAM.
                                   ASSESSED VALUE MAP                                      ROUND  1
```

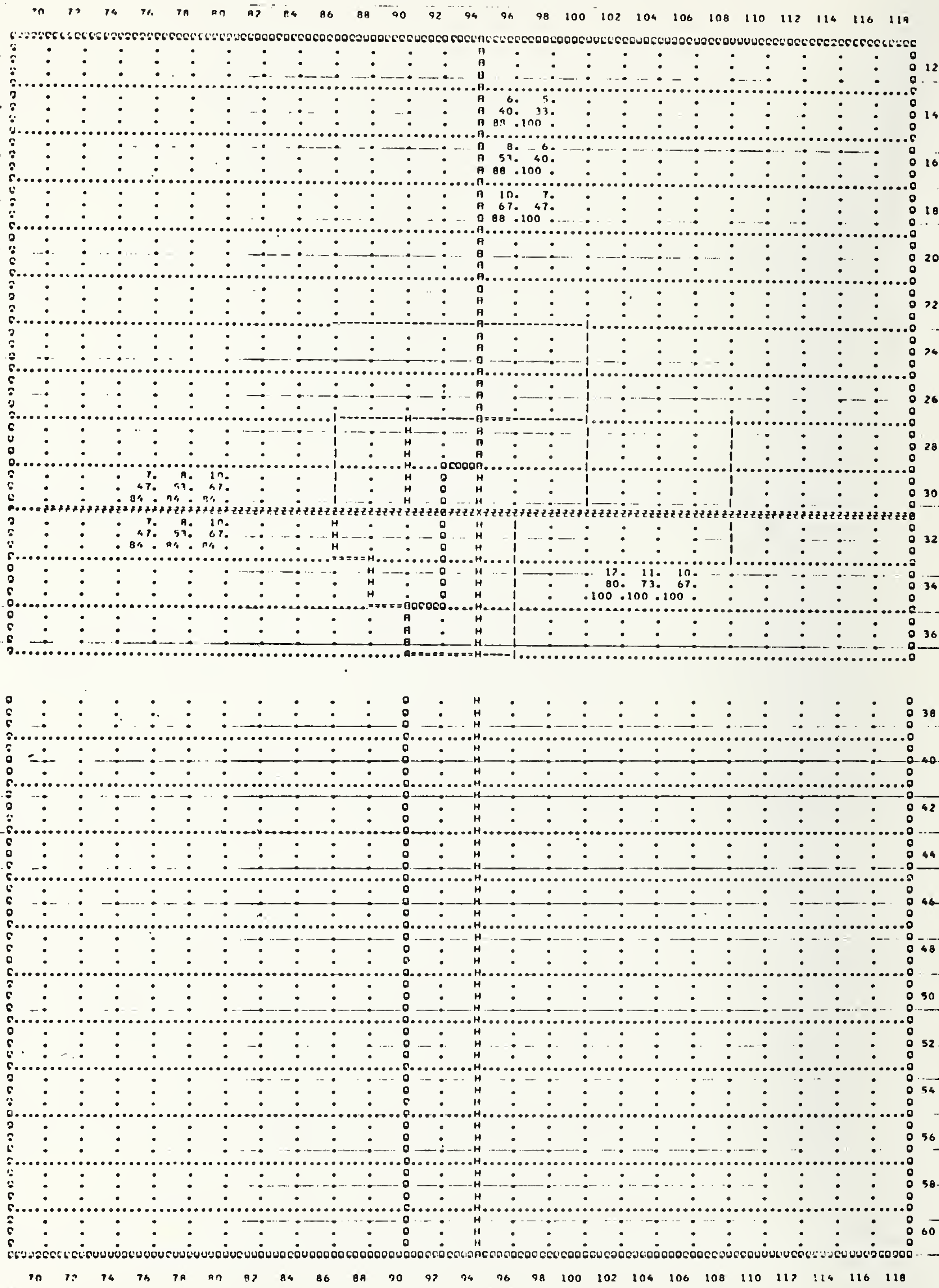
FIGURE 8



```
          PARCELS                                  PARCEL EDGES                       INTERSECTIONS
  TOP ROW:    ASSESSED LAND VALUE           .. .. BOARDED                      + TYPE 1 TERMINAL
  MIDDLE ROW: ASSESSED BLDG VALUE           -- || TYPE 1 ROAD                  X TYPE 2 TERMINAL
  BOTTOM ROW: TOTAL ASSESSED VALUE          == HH TYPE 2 ROAD                  * TYPE 3 TERMINAL
         ALL VALUES IN $100,000             ZZ NN TYPE 3 ROAC
                                            OO OO JURISDICTION BOUNDARY
```

FIGURE 9a

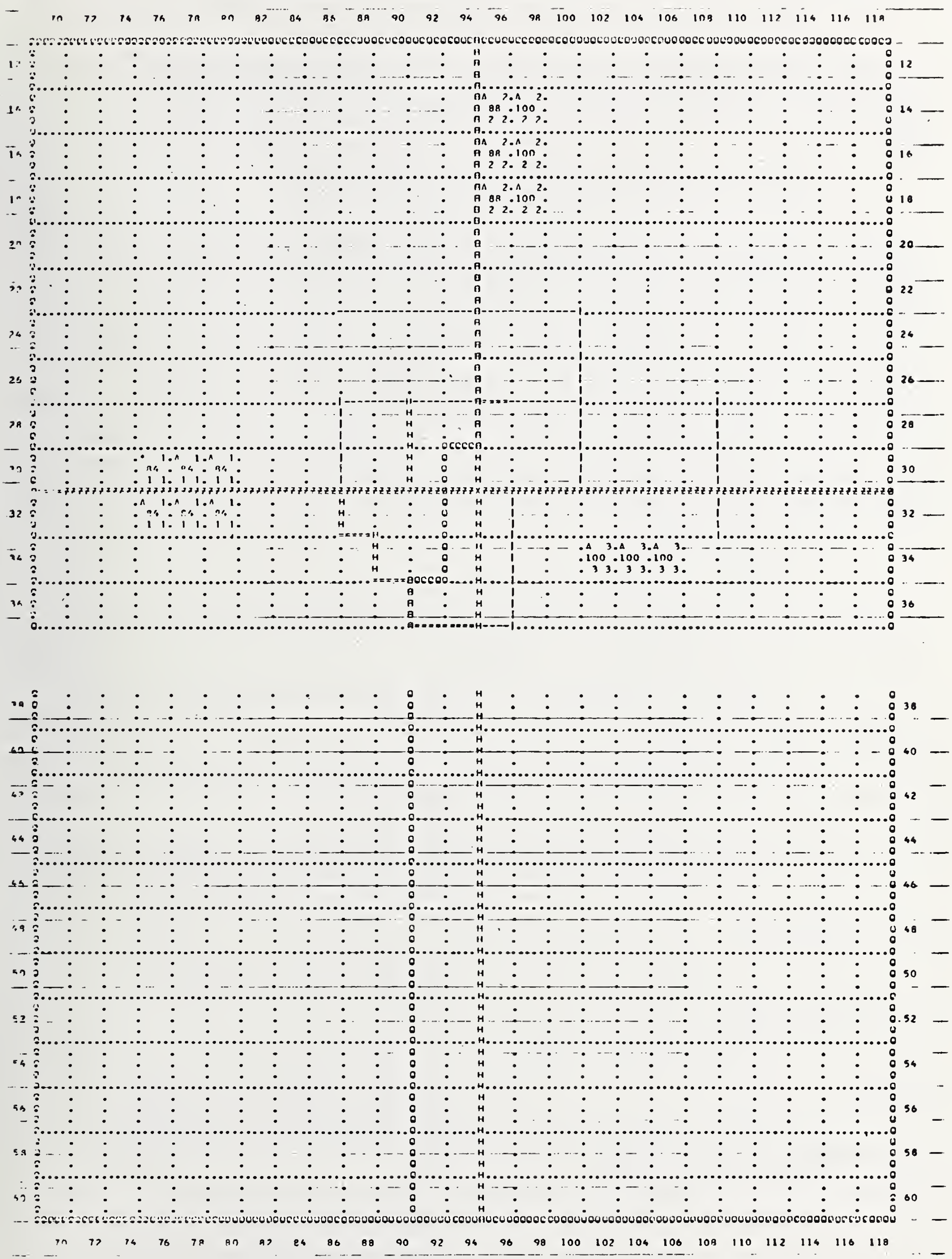
```
TWO CITY--HOWARD UNIVERSITY URBAN SYSTEMS ENGINEERING PROGRAM.
FARM ASSESSED AND MARKET VALUE MAP
                                                                  ROUND  1
```



```
PARCELS                                          PARCEL EDGES                     INTERSECTIONS
-------                                          ------------                     -------------
TOP ROW:      ASSESSED VALUE OF                  .. .. ROAD BED                   + TYPE 1 TERMINAL
              FARMLAND (IN $100,000)             -- || TYPE 1 ROAD                X TYPE 2 TERMINAL
MIDDLE ROW:   MARKET VALUE OF                    == HH TYPE 2 ROAD                # TYPE 3 TERMINAL
              FARMLAND (IN $100,000)             ## MM TYPE 3 ROAD
BOTTOM ROW:   PERCENT OF PARCEL                  OO OO JURISDICTION BOUNDARY
              IN FARMLAND
```

FIGURE 9b

```
TWO CITY--HOWARD UNIVERSITY URBAN SYSTEMS ENGINEERING PROGRAM.
 FARM MAP                                                                      ROUND  1
```



```
 PARCELS                                           PARCEL EDGES                     INTERSECTIONS
 -------                                           ------------                     -------------
 TOP LEFT:      OWNER                              .. .. ROAD BED                   + TYPE 1 TERMINAL
 TOP RIGHT:     FARM CODE NUMBER                   -- || TYPE 1 ROAD                X TYPE 2 TERMINAL
 MIDDLE:        PERCENT OF PARCEL                  == HH TYPE 2 ROAD                * TYPE 3 TERMINAL
                IN FARMLAND                        ZZ ** TYPE 3 ROAD
 BOTTOM LEFT:   FARM TYPE                          OO OO JURISDICTION BOUNDARY
 BOTTOM RIGHT:  FERTILIZER LEVEL
```

C. Employment Detail

1. Part-time Work Allocation (Figure 10)

This output indicates the location of all part-time employers (ADED means teachers for adult education), time units used (by employees), and salary offered. This information is given for each class.

2. Employment Selection Information (Figure 11)

This output gives the following information about population units living in the city: location of their residences; number of P1's unemployed; employment location; number of P1's working there; and the salary offered to each worker. Next the output indicates the amount of time spent traveling to and from work and the total costs of travel to work by the various modes. It also shows the route and mode of travel which these population units take to work. This is done by listing the intersections passed, where a new mode is used, or where travel stops. The route is traced from work to home. An intersection is a four or five digit number, which may be preceded by a bus or rail route number if the P1 got off the bus or rail system at that intersection. This information is presented for each class of resident. Figure 11 shows the Low Income Class.

3. Employment Summary (Figure 12)

This output summarizes the employment in the entire city. It shows employment by class and for all classes.

a. Number of Residences - the number of different locations at which a particular class lives in the city.

b. P1's Employed at this Level - the numebr of population units employed in a job at their socio-economic class.

c. P1's Employed at Lower Level - the number of population units employed in jobs below their socio-economic class.

d. P1's Unemployed - the number of population units which are not employed.

e. Total Population Units - the total numebr of P1's of the class on the board.

f. Part-Time Units Worked - the total number of part-time units worked by the class.

g. Number of Jobs Still Available - the number of unfilled jobs available to each class.

FIGURE 10

```
PART-TIME WORK ALLOCATION FOR   HIGH INCOME CLASS

RESIDENCE  EMPLOYER   TIME UNITS   SALARY
-------------------------------------------


   8836       9630         50      11000.
   9838       9632         30      11000.
   8830       9230        100      10600.
   8830       9630         10      11000.
   9834       9632         50      11000.
   9834       9630         20      11000.
   9834       9832         80      10000.
   9834       9430         70      10500.
   9638       9430         40      10500.
   9034       9430         40      10500.
   9438       9430         30      10500.
   9238       9626         10      11000.
   9436       9626        120      11000.
   8430       9626         30      11000.
   8430       9828         50      11000.
   9038       9828         10      11000.
   9836       9830         80      10000.
   9836       9828         20      11000.
```

FIGURE 11

```
                         EMPLOYMENT SELECTION INFORMATION FOR    LOW INCOME CLASS

RESIDENCE  EMPLOYER  POPUL.  SALARY  TIME  AUTO   BUS   RAIL   ROUTE
 LOCATION  LOCATION  UNITS           UNITS COST   COST  COST

   9622    UNEMPLOYED   0

             9626       2    2800.    5.0 240.0  0.0   0.0       9525    9523

   9822    UNEMPLOYED   0

             9626       3    2800.   12.5 365.0  0.0   0.0       9525    9523    9723

  10022    UNEMPLOYED   0

             9626       5    2800.   20.0 490.0  0.0   0.0       9525    9523    9723    9923
             9828       2    2800.   17.5 465.0  0.0   0.0       9927   10127   10125   10123

   9624    UNEMPLOYED   0

             9630       2    2800.   14.9 438.0  0.0   0.0       9529    9527    9525
             9432      22    2800.   23.0 600.0  0.0   0.0       9531    9529    9527    9525
             9632       4    2900.   23.0 600.0  0.0   0.0       9531    9529    9527    9525

   9824    UNEMPLOYED  14

             9228      16    2500.   25.0 590.0  0.0   0.0       9327    9527    9525    9523    9723
             9432       2    2800.   35.5 825.0  0.0   0.0       9531    9529    9527    9525    9523    9723

  10024    UNEMPLOYED   0

             9626      11    2800.   18.0 473.7  0.0   0.0       9727    9927   10127   10125
             9632       7    2900.   27.5 665.0  0.0   0.0       9731    9931   10131   10129   10127   10125

  10224    UNEMPLOYED   0

             9626       7    2800.   18.0 473.7  0.0   0.0       9727    9927   10127   10125

  10424    UNEMPLOYED   0
```

FIGURE 12

EMPLOYMENT SUMMARY

	LOW INCOME	MIDDLE INCOME	HIGH INCOME	ALL CLASSES
NUMBER OF RESIDENCES	11	24	27	62
PI'S EMPLOYED AT THIS LEVEL	133	198	200	531
PI'S EMPLOYED AT LOWER LEVEL	0	0	6	6
PI'S UNEMPLOYED	14	0	0	14
TOTAL POPULATION UNITS	147	198	206	551
PART-TIME UNITS WORKED	658	1032	852	2542
NUMBER OF JOBS STILL AVAILABLE	72	3	0	75

D. Commercial Detail

The commercial diagnostics print in the following order:

Personal Goods Allocation Summary
Personal Services Allocation Maps

Business Goods Allocation Summary
Business Goods Allocation Map
Business Goods Government Contracts Allocation

Business Services Allocation Summary
Business Services Allocation Map
Business Services Government Contracts Allocation Summary

Terminal Allocation Summary
Terminal Allocation Map

Associated with these commercial activities are three maps which help to display the detail activity in a summary format.

1. Personal Goods Allocation Summary (Figure 13a)

This tabular summary provides detail on where people are buying their goods for normal consumption and recreation and where residences are buying their goods for maintenance. The first section of the summary applies to the PG's. It lists the code number of each PG, the last one being the code number for the Outside system. The location, owner, level, effective capacity, capacity used, price per unit, and gross income of each PG is given. Outside has no owner, level or effective capacity (the capacity is infinite). Its price per unit is always $13,000.

The second section provides detail on all purchasers of personal goods. The first item of information is the code number of the PG at which the purchaser is buying. The list is ordered by the code numbers of the PG's, so those purchasing form the Outside are last on the list. The location of the buyer, its class or residence type, the social decision-maker controlling the class or the economic decision-maker controlling the residence, the number of units consumed, the transportation costs, the purchase cost, and the total cost are given. The transportation cost printed for a residence is a dummy cost used for allocation.

2. Personal Goods Allocation Map (Figure 13b)

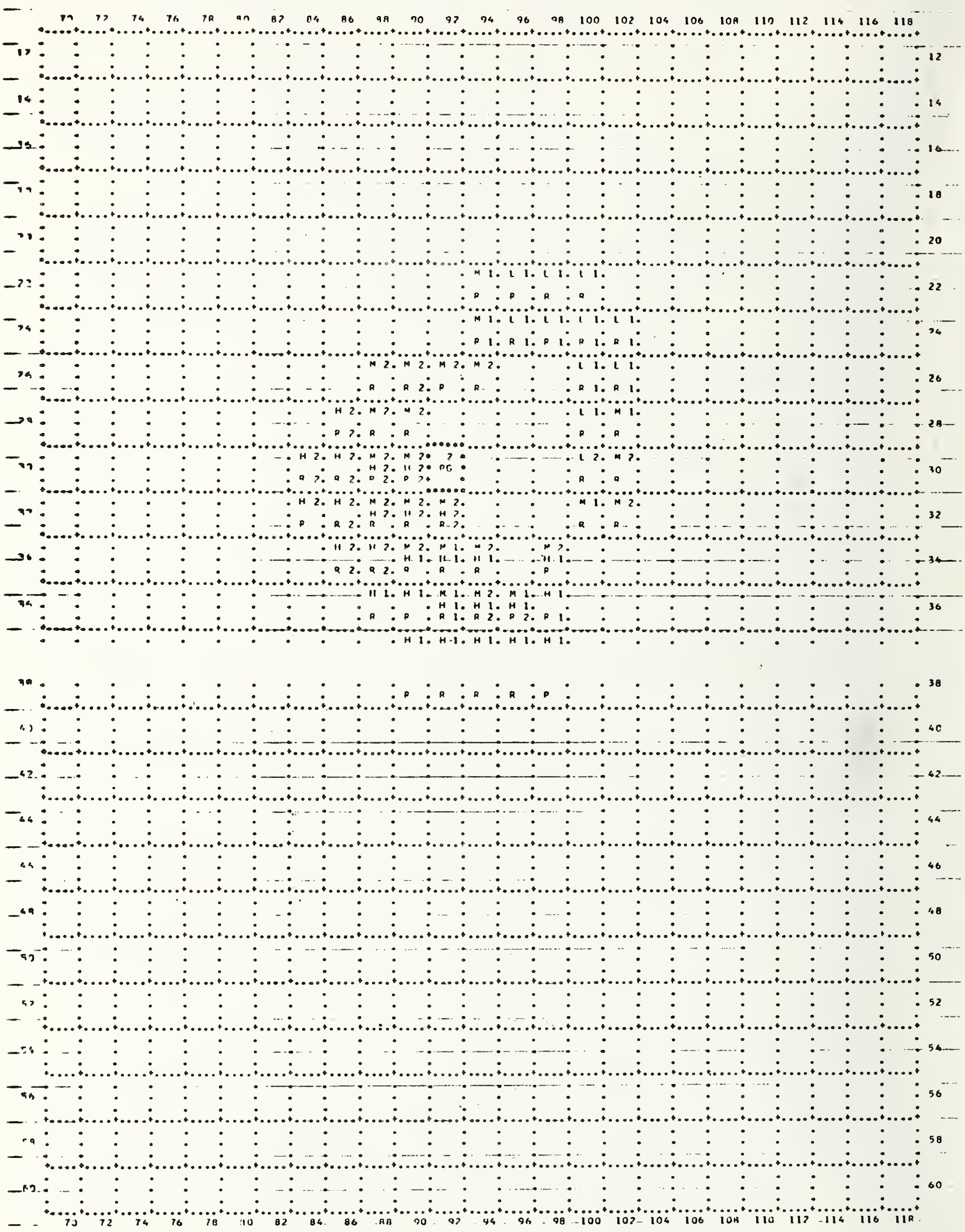
This Map presents the same information given in the Allocation Summary in a single page format. The top number gives the P1 class and the PG establishment serving them. Since there could be, at most, two classes of residences on a parcel the other class is presented in the middle number with the PG business they use. The economic decision maker who uses the residence also purchases PG and the place of purchases, the PG establishment is presented in the bottom number.

FIGURE 13a

```
***********************************************************************************************************
                    TWOCITY
                    PERSONAL GOODS  ALLOCATION SUMMARY                                          ROUND  1
***********************************************************************************************************


                                        PERSONAL GOODS
                                        --------------

         NUMBER   LOCATION   OWNER   LEVEL   CAPACITY   CAPACITY USED   PRICE/CU   GROSS INCOME
         ------   --------   -----   -----   --------   -------------   --------   ------------

           1          OUTSIDE                                1528         13000       19864000.

           2        9230       E       2      14679         15085          9900      149341500.

                                               TOTAL        16613                   169205500.


                                        CUSTOMERS
                                        ---------

     PERSONAL GOODS                CLASS OR   DECISION MAKER   CONSUMPTION   TRANSPORTATION     PURCHASF       TOTAL
      ASSIGNED TO       LOCATION   LAND USE    CONTROLLING        UNITS           COST            COST          COST
     --------------     --------   --------   --------------   -----------   --------------     --------       -----

           1              9222       RA            D                25               0.          325000.      325000.
           2              9622       LOW           D                42           49350.          415800.      465150.
           1              9822       LOW           D                63               0.          819000.      819000.
           1             10022       LOW           D               148               0.         1924000.     1924000.
           2              9424       RA            C                 2            1850.           19800.       21650.
           2              9424       MID           C                28           25900.          277200.      303100.
           2              9624       RB            F                12           11100.          118800.      129900.
           2              9624       LOW           D               590          545750.         5841000.     6386750.
           2              9824       RB            C                18           27900.          178200.      206100.
           1              9824       LOW           D               674               0.         8762000.     8762000.
           1             10024       RB            C                26               0.          338000.      338000.
           1             10024       LOW           D               379               0.         4927000.     4927000.
           1             10224       RA            G                13               0.          169000.      169000.
           1             10224       LOW           D               148               0.         1924000.     1924000.
           2              8826       MID           C               114           76950.         1128600.     1205550.
```

FIGURE 13b

```
TWO CITY--HOWARD UNIVERSITY URBAN SYSTEMS ENGINEERING PROGRAM.
                 PERSONAL GOODS ALLOCATION MAP                                   ROUND  1
```



```
                         PARCELS
TOP ROW:    PI CLASS AND SERVING PG           ******  ASTERISKS IDENTIFY
MIDDLE ROW: PI CLASS AND SERVING PG           * NN *  LOCATION OF  PG
BOTTOM ROW: RESIDENCE AND SERVING PG          * PG *
                                              *    *  NN IS THE
                                              ******  CODE NUMBER
```

3. Personal Services Allocation Summary (Figure 14a)

The explanation is the same as that of the Personal Goods Allocation Summary on page 130.

4. Personal Services Allocation Map (Figure 14b)

The presentation is the same as in the Personal Goods Allocation Map described on page 130.

5. Business Goods Allocation Summary (Figure 15a)

Like the Personal Goods and Personal Services Allocation Summaries the Business Goods allocations present the buyers of the goods. In addition, the summary displays the Government contracts since the government is also a buyer of Business Goods for the maintenance to roads, plants and machinery that the Government owns.

6. Business Services Allocation Summary (Figure 15b)

The same information presented for the Business Goods is presented for the Business Services in this output.

7. Business Commercial Map (Figure 15c)

The presentation in this map sums up the information in 5 and 6 above.

The land use of each parcel that buys Business Goods and Business Services is presented in the top number. The middle and bottom numbers display the Business Goods and Business Services establishment numbers respectively. The establishment numbers refers to the numbers given each Business Goods and Business Services business in the Allocation Summaries of 5 and 6 above.

8. The Terminal Usage (Figure 16a)

Each Terminal user is listed with its drain in capacity units shipped through the terminal. The location and level of terminal is presented below.

9. The Terminal Allocation Map (Figure 16b)

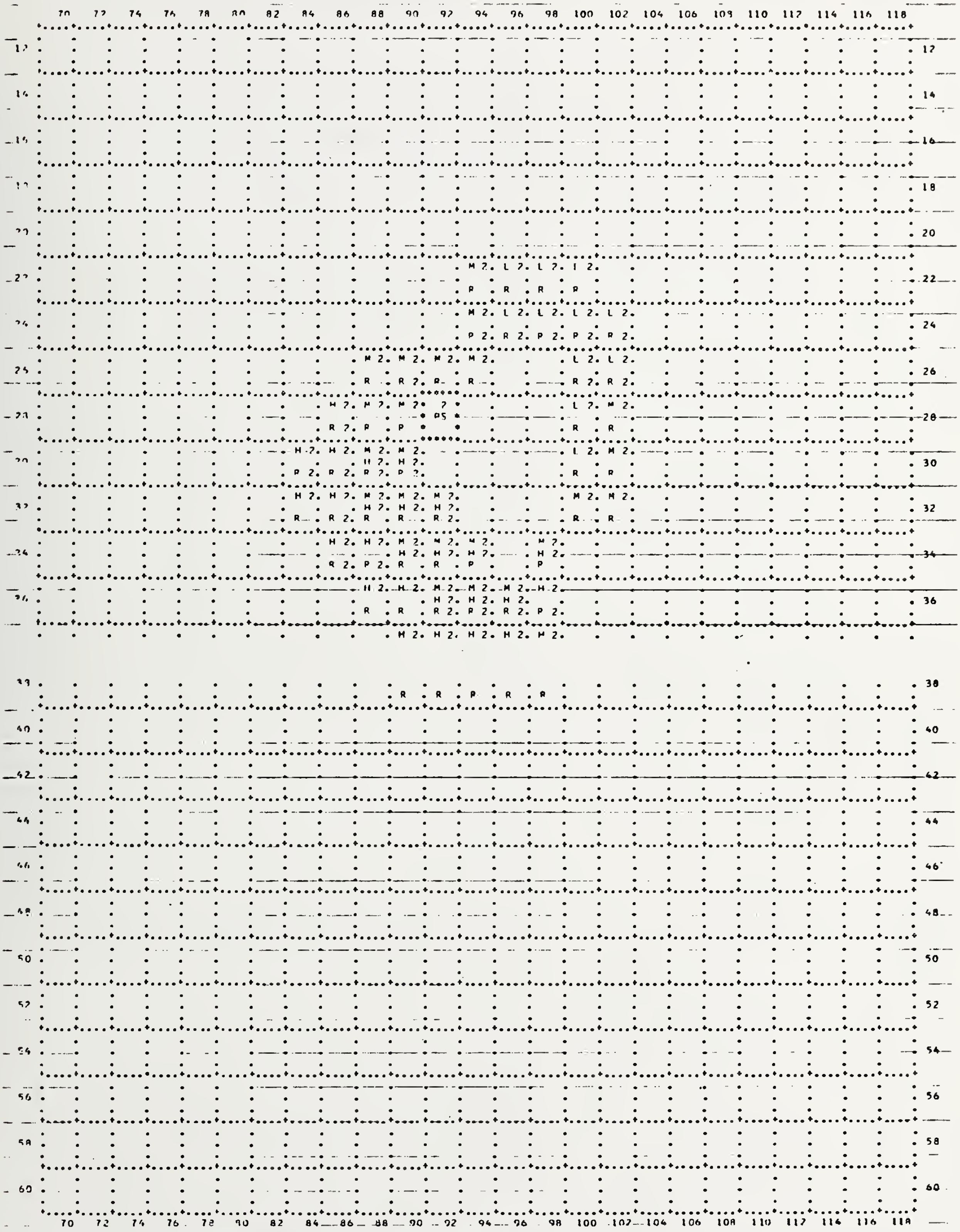
The map shows the location of the terminals.

FIGURE 14a

```
**********************************************************************************************************
          TWOCITY
       PERSONAL SERVICES  ALLOCATION SUMMARY                                                    ROUND  1
**********************************************************************************************************


                                   PERSONAL SERVICES
                                   -----------------

     NUMBER   LOCATION   OWNER   LEVEL   CAPACITY   CAPACITY USED   PRICE/CU   GROSS INCOME
     ------   --------   -----   -----   --------   -------------   --------   ------------

       1          OUTSIDE                                   769       13000       9997000.

       2        9228       8       1       7200            6291        9700      61022700.

                                          TOTAL            7060                  71019700.


                                      CUSTOMERS
                                      ---------

  PERSONAL SERVICES              CLASS OR   DECISION MAKER   CONSUMPTION   TRANSPORTATION    PURCHASE      TOTAL
     ASSIGNED TO       LOCATION  LAND USE    CONTROLLING        UNITS           COST           COST         COST
  -----------------    --------  --------  ---------------  -----------   --------------    --------      -----

          2              9222       RA            D               11           14300.        106700.      121000.
          2              9622       LOW           D               14           12950.        133800.      148750.
          2              9822       LOW           D               21           27300.        203700.      231000.
          2             10022       LOW           D               49           82075.        475300.      557375.
          2              9424       RA            C                1             675.          9700.       10375.
          2              9424       MID           C               11            7425.        106700.      114125.
          2              9624       RB            F                6            4050.         58200.       62250.
          2              9624       LOW           D              196          132300.       1901200.     2033500.
          2              9824       RB            C                9           11700.         87300.       99000.
          2              9824       LOW           D              224          291200.       2172800.     2464000.
          2             10024       RB            C               13           20150.        126100.      146250.
          2             10024       LOW           D              126          195300.       1222200.     1417500.
          2             10224       RA            G                5            7750.         48500.       56250.
          2             10224       LOW           D               49           75950.        475300.      551250.
          2              8826       MID           C               46           19550.        446200.      465750.
```

FIGURE 14b

TWO CITY--HOWARD UNIVERSITY URBAN SYSTEMS ENGINEERING PROGRAM.
PERSONAL SERVICES ALLOCATION MAP
ROUND 1



PARCELS
TOP ROW: PI CLASS AND SERVING PS
MIDDLE ROW: PI CLASS AND SERVING PS
BOTTOM ROW: RESIDENCE AND SERVING PS

```
******  ASTERISKS IDENTIFY
* NN *  LOCATION OF  PS
* PS *
*    *  NN IS THE
******  CODE NUMBER
```

FIGURE 15a

```
*****************************************************************************************************************
                    TWOCITY
                    BUSINESS GOODS  ALLOCATION SUMMARY                                                 ROUND  1
*****************************************************************************************************************


                                              BUSINESS GOODS
                                             ---------------

          NUMBER   LOCATION   OWNER   LEVEL   CAPACITY   CAPACITY USED   PRICE/CU   GROSS INCOME
          ------   --------   -----   -----   --------   -------------   --------   ------------

            1          OUTSIDE                                956        130000      124280000.

            2        9830       C       1       3300          966        100000       96600000.


                                               TOTAL         1922                    220880000.


                                              CUSTOMERS
                                              ---------

      BUSINESS GOODS                CLASS OR   DECISION MAKER   CONSUMPTION   TRANSPORTATION   PURCHASE    TOTAL
       ASSIGNED TO      LOCATION    LAND USE    CONTROLLING        UNITS           COST           COST       COST
      --------------    --------    --------   --------------   -----------   --------------   --------    -----

            1             9626         CR             G              368              0.       47840000.   47840000.
            2             9228         PS             B              193        1302750.       19300000.   20602750.
            2             9828         TE             G              345         345000.       34500000.   34845000.
            1             9230         PG             E              558              0.       72540000.   72540000.
            2             9630         PA             G              100         800000.       10000000.   10800000.
            2             9432         FO             G               58          81200.        5800000.    5881200.
            2             9632         MP             A              255         714000.       25500000.   26214000.
```

FIGURE 15a Continued

GOVERNMENT CONTRACTS

BUSINESS GOODS	DEPARTMENT	CONSUMPTION UNITS	COST
2	MS1	4	400000
1	MS1	3	390000
2	SC1	11	1100000
1	SC1	5	650000
1	MS2	14	1820000
1	SC2	8	1040000

FIGURE 15b

```
**************************************************************************************************************
                           TWOCITY
                       BUSINESS SERVICES  ALLOCATION SUMMARY                                        ROUND  1
**************************************************************************************************************


                                      BUSINESS SERVICES
                                      -----------------

           NUMBER    LOCATION    OWNER    LEVEL    CAPACITY    CAPACITY USED    PRICE/CU    GROSS INCOME
           ------    --------    -----    -----    --------    -------------    --------    ------------

             1           OUTSIDE                                      17          130000        2210000.

             2         9832        B        1          958           913          100000       91300000.

                                                     TOTAL           930                       93510000.


                                         CUSTOMERS
                                         ---------

   BUSINESS SERVICES                 CLASS OR    DECISION MAKER    CONSUMPTION    TRANSPORTATION    PURCHASE       TOTAL
      ASSIGNED TO        LOCATION    LAND USE     CONTROLLING         UNITS            COST           COST          COST
   -----------------     --------    --------    --------------    -----------    --------------    --------       -----

           2               9626         CR             G               185           1248750.       18500000.     19748750.
           2               9228         PS             B                64            432000.        6400000.      6832000.
           2               9828         TE             G               261           2414250.       26100000.     26514250.
           2               9230         PG             E               256            768000.       25600000.     26368000.
           2               9630         PA             G                44             22000.        4400000.      4422000.
           2               9432         FO             G                21             36750.        2100000.      2136750.
           2               9632         MP             A                81             40500.        8100000.      8140500.
```

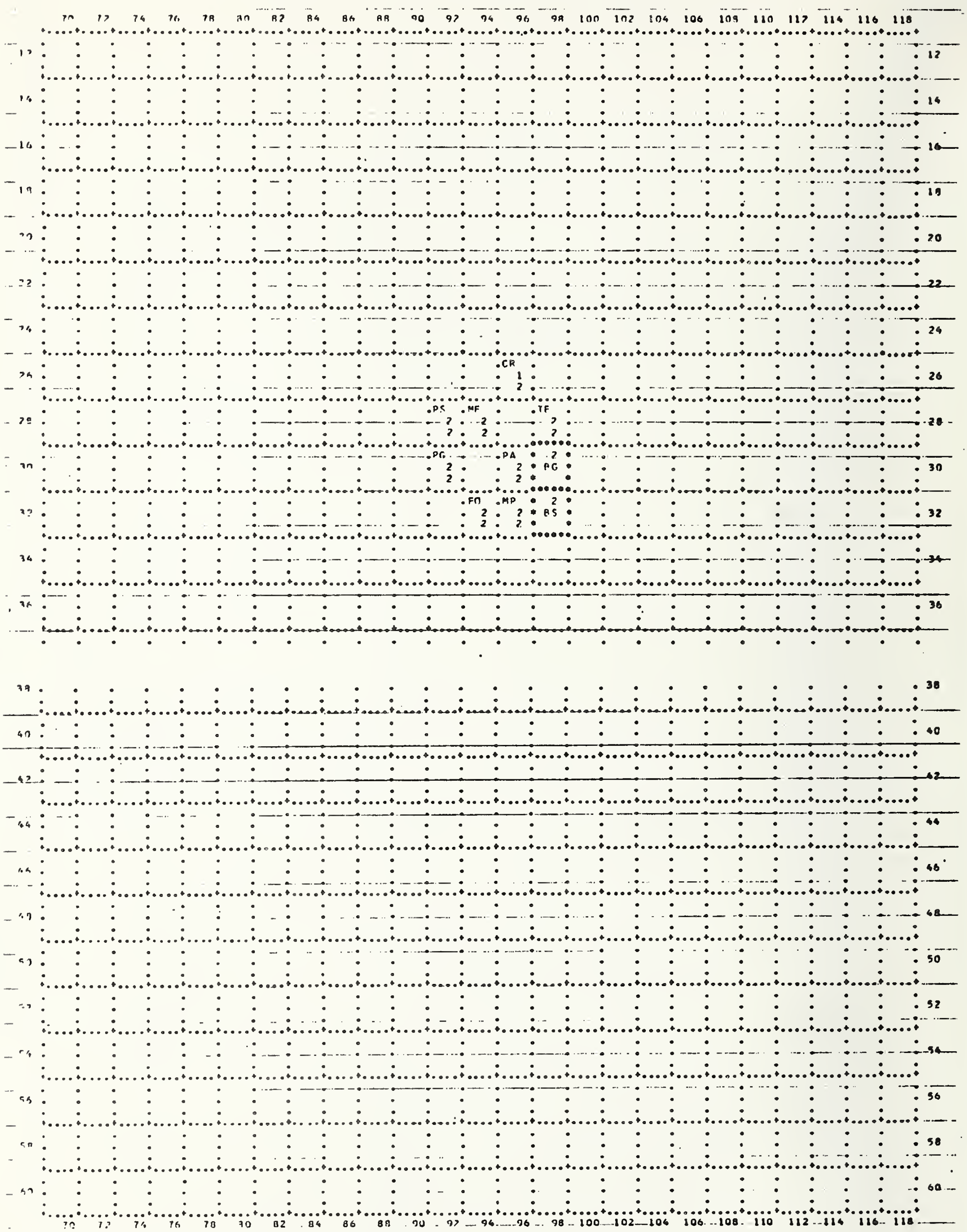
FIGURE 15b Continued **GOVERNMENT CONTRACTS**

BUSINESS SERVICES	DEPARTMENT	CONSUMPTION UNITS	COST
1	MS1	3	390000
2	SC1	1	100000
1	SC1	5	650000
1	MS2	6	780000
1	SC2	3	390000

FIGURE 15c

TWO CITY--HOWARD UNIVERSITY URBAN SYSTEMS ENGINEERING PROGRAM.
BUSINESS COMMERCIAL MAP

ROUND 1



PARCELS

TOP ROW: LAND USE
MIDDLE ROW: BG SERVING PARCEL
BOTTOM ROW: BS SERVING PARCEL

```
******  ASTERISKS IDENTIFY
* NN *  LOCATION OF BG OR BS
* BX *
*    *  NN IS THE
******  CODE NUMBER
```

FIGURE 16a

TERMINAL USAGE SUMMARY

```
CUSTOMERS

   LOCATIONS  LAND USE  REQUIREMENTS

      9626       CR        6000
      9828       TE        2000
      9630       PA        3000
      9830       BG         966
      9432       FO        3000
      9632       MP        6000

TERMINALS

NUMBER  LOCATION  LEVEL

   1       9531      2
  16      10931      2
```

FIGURE 16b

```
TERMINAL ALLOCATION MAP

      70   72   74   76   78   80   82   84   86   88   90   92   94   96   98  100  102  104  106  108  110  112  114
  12    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0   12
  14    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0   14
  16    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0   16
  18    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0   18
  20    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0   20
  22    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0   22
  24    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0   24
  26    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0   26
  28    0    0    0    0    0    0    0    0    0    0    0    0    0    0    1    0    0    0    0    0    0    0    0   28
  30    0    0    0    0    0    0    0    0    0    0    0    0    0    1    1    0    0    0    0    0    0    0    0   30
                                                                     *1*                                 *2*
  32    0    0    0    0    0    0    0    0    0    0    0    0    1    1    0    0    0    0    0    0    0    0    0   32
  34    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0   34
  36    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0   36
  38    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0   38
  40    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0   40
  42    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0   42
  44    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0   44
  46    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0   46
  48    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0   48
  50    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0   50
  52    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0   52
      70   72   74   76   78   80   82   84   86   88   90   92   94   96   98  100  102  104  106  108  110  112  114
```

E. Migration Detail

1. Migration Detail (Figure 17)

There are reasons other than dissatisfaction for which a population unit might move out of its housing. A fixed percentage of all unemployed and under-employed population units automatically leave their housing and move to the Outside System, i.e. they leave the simulated urban region and disappear. In addition, PI, population units may leave over crowded housing (housing over 120% occupied). Those displaced and unable to find acceptable housing would join those leaving to the Outside System. Another fixed percentage is chosen randomly to seek better housing. If they are unable to find housing of a better neighborhood index they too would leave the urban region.

In addition to the types of out-migration explained above, there is in-migration as a result of natural population growth and the attractiveness of local employment opportunities. Local migration is a result of any of the above reasons but in each case the mover finds housing that is satisfactory within the local system. The Migration Detail Output describes all of the above types of migration in detail.

F. Summary Information

1. Demographic and Economic Statistics (Figure 18)

This output summarizes a wide variety of information for the simulated area. It includes statistics on population, developed and undeveloped land, assessed value of land and developments, dissatisfaction levels, total registered voters, population units, public adult education, average educational level, welfare, student/teacher ratio, school enrollment, housing, employment, income and jobs. A final section "transactions with the National Economy" summarizes income from and expenditures to the outside system and indicates the condition of the National Economy Business Cycle. (Note: The gross income rate of an industry indicates the ratio of its present income to the typical income.)

2. Transactions with the National Economy. (Figure 19)

a. Income from the National Economy through Federal State Aid and Sales to the National Economy are tabulated and a total presented.

b. Expenditures to the National Economy through Federal and State Taxes and Goods brought from the National Economy are tabulated and a total presented.

c. The National Economy Business Cycle for the particular round is presented for each type of transaction.

FIGURE 17

```
****************************************************************************************************************************
                          TWOCITY
                      MIGRATION DETAIL                                                                          ROUND  1
****************************************************************************************************************************

                              SOCIAL    NUMBER
                             DECISION     OF              QUALITY OF    NUMBER          FROM/TO    REASON FOR
         PARCEL OWNER TYPE    MAKER      PI'S    CLASS       LIFE        MOVED           PARCEL       MOVING       EMPLOYER
         ------ ----- ----  --------   ------   -----   -----------   ------          -------   ---------------   --------


          9222    D   RA12

          9422    B   RA 0      C          2   MIDDLE        339

          9622    C   RA 1      D          2   LOW           256

          9822    G   RA 2      D          3   LOW           231

         10022    F   RA 4      D          7   LOW           229

          9424    C   RA 1      C          1   MIDDLE        279

          9624    F   RB 2      D         28   LOW           272

          9824    C   RB 3      D         32   LOW           251

         10024    C   RB 1      D         18   LOW           276

         10224    G   RA 4      D          7   LOW           235

          8826    B   RA 3      C          4   MIDDLE        251

          9026    F   RA 3      C          4   MIDDLE        239

          9226    E   RA 3      C          6   MIDDLE        274

          9426    E   RA 5      C          5   MIDDLE        274

         10026    G   RB 2      D         30   LOW           276

         10226    D   RA 3      D          7   LOW           247
```

- FIGURE 18

```
********************************************************************************************************
      TWOCITY
                DEMOGRAPHIC AND ECONOMIC STATISTICS                                          ROUND  1
********************************************************************************************************
                                                                JURISDICTION  JURISDICTION  JURISDICTION
                                                   TOTAL             I             II            III
  *************************************         **********       **********    **********    **********

  TOTAL POPULATION                                274500           125000        149500           0
                            LOW    CLASS           73500                0         73500           0
                            MIDDLE CLASS           98000            63000         35000           0
                            HIGH   CLASS          103000            62000         41000           0

  PERCENT CHANGE OVER PREVIOUS YEAR                    0
  AVERAGE POPULATION PER PARCEL                      439              422           454           0

  DEVELOPED LAND (IN PARCELS)                         21                8            12           0
  UNDEVELOPED LAND                                   604              288           317           0
  TOTAL LAND AREA                                    625              296           329           0

  ASSESSED VALUE OF LAND                           7796.            2658.         5138.          0.
      IN MILLIONS

  ASSESSED VALUE OF DEVELOPMENTS                    535.             138.          397.          0.
      IN MILLIONS
  AVERAGE QUALITY OF LIFE INDEX                      255              258           252           0
  NUMBER OF REGISTERED VOTERS                      88293            45286         43007           0
  NO. IN PUBLIC ADULT EDUCATION                    60760            20160         40600           0

  AVERAGE EDUCATIONAL LEVEL                           61               75            48           0
      LOW                                             17                0            17           0
      MIDDLE                                          65               65            66           0
      HIGH                                            87               86            89           0

  NO. OF WORKERS RECEIVING WELFARE                  2800                0          2800           0

  STUDENT/TEACHER RATIO                                4                2            18           0

  SCHOOL ENROLLMENT
      PUBLIC                                       19862             5460         14402           0
      PRIVATE                                      49338            28580         20758           0

  HOUSING UNITS
      SINGLE    DWELLINGS                            112               72            40           0
      MULTIPLE  DWELLINGS                             27                7            20           0
      HIGH RISE APARTMENTS                             7                5             2           0

  VACANCY RATE        (PERCENT)                        6                9             1           0
      NEGATIVE MEANS OVERCROWDED


  NUMBER OF EMPLOYED WORKERS                       82680            35040         47640           0
      LOW                                          26600                0         26600           0
      MIDDLE                                       31360            20160         11200           0
      HIGH                                         24720            14880          9840           0


  NUMBER EMPLOYED IN
      LIGHT      INDUSTRY                          37600            15440         22160           0
      HEAVY      INDUSTRY                          17800             6040         11760           0
      NATIONAL   SERVICES                              0                0             0           0
      CONSTRUCTION INDUSTRY                            0                0             0           0
      BUSINESS   GOODS                              2800             2000           800           0
      BUSINESS   SERVICES                           3840                0          3840           0
      PERSONAL   GOODS                              6080             6080             0           0
      PERSONAL   SERVICES                           5680             2480          3200           0
      MUNICIPAL  SERVICES                           5120             1440          3680           0
      SCHOOLS                                       2760             1560          1200           0
      RAIL                                             0                0             0           0
      BUS                                              0                0             0           0
      FEDERAL-STATE                                 1000                0          1000           0
  NUMBER OF UNEMPLOYED WORKERS                      2800                0          2800           0
      LOW                                           2800                0          2800           0
      MIDDLE                                           0                0             0           0
      HIGH                                             0                0             0           0


  UNEMPLOYMENT RATE   (PERCENT)                     3.28              0.0          5.55         0.0
      LOW                                           9.52              0.0          9.52         0.0
      MIDDLE                                        0.0               0.0          0.0          0.0
      HIGH                                          0.0               0.0          0.0          0.0

  PERCENT EARNING        UNDER $ 5,000                36                6            58           0
  PERCENT EARNING $5,000 TO $10,000                   34               51            21           0
  PERCENT EARNING        OVER $10,000                 29               41            19           0
```

FIGURE 19

```
                         TRANSACTIONS WITH THE NATIONAL ECONOMY
                         **************************************
                         **************************************


INCOME FROM THE NATIONAL ECONOMY
********************************

     FEDERAL - STATE AID RECEIVED

          SCHOOLS   FOR SCHOOL  CONSTRUCTION                 $         0
          SCHOOLS   FOR CURRENT EXPENDITURES                 $ 4,468,950
          MUNICIPAL SERVICES    FOR WELFARE PAYMENTS         $ 5,232,500
          HIGHWAYS              FOR ROAD CONSTRUCTION        $ 2,666,666

     TOTAL                                                  $ 12,368,116


     SALES TO THE NATIONAL ECONOMY

          HEAVY INDUSTRY              3955 UNITS FOR       $ 741,089,000
          LIGHT INDUSTRY              1952 UNITS FOR       $ 379,580,000
          NATIONAL SERVICES              0 UNITS FOR       $           0
          RAIL COMPANY          EQUIPMENT WORTH            $           0
          BUS  COMPANY            EQUIPMENT WORTH          $           0

     TOTAL                                               $ 1,120,669,000


TOTAL INCOME FROM THE NATIONAL ECONOMY                   $ 1,133,037,116



 EXPENDITURES TO THE NATIONAL ECONOMY
 ************************************
     FEDERAL - STATE    TAXES

          PERSONAL  INCOME TAX                                  $ 79,200

          CORPORATE INCOME TAX                             $ 348,553,984

          STATE  SALES  TAX                                 $ 20,438,544

          TOTAL                                            $ 369,071,728

     GOODS BOUGHT FROM THE NATIONAL ECONOMY

          BUSINESS GOODS    SERVICE AND MAINTENANCE         $ 81,428,000
          BUSINESS SERVICES SERVICE AND MAINTENANCE        $ 466,830,624

          RAIL COMPANY      EQUIPMENT WORTH                        $   0
          BUS  COMPANY      EQUIPMENT WORTH                        $   0

          DUE TO LOCAL INSUFFICIENCY
               PERSONAL GOODS                               $ 19,864,000
               PERSONAL SERVICES                             $ 9,997,000
               BUSINESS GOODS                              $ 124,280,000
               BUSINESS SERVICES                             $ 2,210,000

          AUTOMOBILE EXPENDITURES                        $ 1,249,275,556
          LAND PURCHASES FROM OUTSIDE WORTH                        $   0

          TOTAL                                          $ 1,953,885,180
     TOTAL EXPENDITURES TO THE NATIONAL ECONOMY          $ 1,972,010,388


NATIONAL ECONOMY BUSINESS CYCLE                    ROUND  1
*******************************                    ********

          GROSS INCOME RATE OF HEAVY INDUSTRY          1.05

          GROSS INCOME RATE OF LIGHT INDUSTRY          1.04

          GROSS INCOME RATE OF NATIONAL SERVICES       1.03

          AVERAGE OUTSIDE LOAN RATE                    5.10

          AVERAGE RETURN ON CONSERVATIVE INVESTMENTS   6.10

          AVERAGE RETURN ON SPECULATIVE INVESTMENTS    8.90

          AVERAGE BOND RATE                            3.10
```

G. Economic Decision-Maker Output

Each of the economic teams receives summary statistics at the beginning of every round of play that describe the cash flow for the previous year, a balance sheet showing net worth, loans made and received, construction in progress, boycotts in operation, and undeveloped land holdings. The team may use any of its resources to achieve whatever objectives it desires.

1. Financial Summary (Figure 20)

a. Cash Flow Statement

A team's cash holdings can be used to purchase additional property, construct any of the eleven types of land uses on property that it owns and which is properly zoned and served with utilities, demolish any building it owns, pay off loans, grant a loan to another team, pay taxes on undeveloped land, or spend it in some miscellaneous way (cash transfer to another team and purchase of national stocks).

Additions to the new balance (i.e., cash) come from income derived by selling property, receiving payment from loans, receiving loans, earning net income from investment (developments) in the local economy, receiving government subsidies, earning interest on savings, and from miscellaneous sources (cash transfers from others and sale of national stocks).

If the team makes no decisions during a particular round, it is still charged interest and principal payments on loans and taxes on undeveloped land. The team also automatically receives loan payments, interst on savings, and net income. This latter figure, however, may be a negative number if the developments of a given team are doing poor business and expenses exceed income.

b. Investments

The second part of the financial summary output shows investments in the national economy. A team may invest as much cash as it wishes in either conservative or speculative national businesses. The national business cycle generates the year by year rate of return for conservative stocks and for speculative stocks. In upswings in the business cycle, the rate of return on speculative stocks will always be larger. The range for the rate of return on conservative stocks is 5% to 7%, and for speculative stocks it is -1% to 10%. The return from national investments is automatically used to purchase additional stock. A team must "disinvest" in order to transfer funds from the otuside investment.

FIGURE 20

```
*        ****************************************************************************************************
                              TWOCITY
                              ECONOMIC DECISION MAKER A    BASIC INDUSTRY OUTPUT                        ROUND  1
******************************************************************************************************************

LOCATION                            9626          9428          9632
CONSTRUCTED LEVEL                   CR 2          MF 1          MP 1
OPERATING LEVEL                     CR 2          MF 0          MP 1
V/C RATIO                            100           100           100
MAINTENANCE LEVEL                    100           100           100
MS DISTRICT                            3             1             0
UTILITY DISTRICT                       2             1             2
DEPRECIATION (%)
    MS                               3.0           3.0           4.0
    FIRE                             2.5           0.0           3.4
    FLOOD                            0.0           0.0           0.0
    WATER QUALITY                    0.0           0.0           0.0
WATER CONSUMPTION (MGD)
    NORMAL SOURCE                  62.00           0.0           0.0
    OUTSIDE                          0.0           0.0        225.00
PERCENT WATER RECYCLED                 0             0             0
EFFLUENT TREATMENT
    TYPE AND LEVEL                  ST 1             0          ST 1
SALARY (PER WORKER IN 100'S)
    HIGH                             110           110           110
    MIDDLE                            55            55            43
    LOW                               28            28            29
EMPLOYEES
  FULL TIME (IN PI'S)
    HIGH                              48             0            19
    MIDDLE                            48             0            15
    LOW                               28             0            18
  PART TIME (IN UNITS)
    HIGH                             160             0            80
    MIDDLE                           160             0           160
    LOW                              160             0           320
EMPLOYMENT EFFECT                   2000             0           952
UNITS PRODUCED                      2000             0           952
PRICE/UNIT OUTPUT                 197900        250500        190000
INCOME
    SALES(PRIVATE)             355800000             0     180880000
EXPENDITURES
    GOODS                       39000000             0      14000000
    SERVICES                    10000000             0       3500000
    MAINTENANCE                 17340000             0      16100000
    UTILITIES                     880000             0        770000
    WATER
      RECYCLING                        0             0             0
      INTAKE PROCESS             1289600             0             0
       OUTFLOW TREATMENT         1612000             0      11700000
      MUNICIPAL SUPPLY                 0             0      40949984
    TRANSPORTATION              27648734             0      12754497
    SALARIES                   126800000             0      50856000
    PROPERTY TAXES               7450000       1067430       2204800
    SALES TAXES                  1990200             0       1008000
    INCOME TAXES                97762820             0      47158530
NET INCOME                      66928246      -1067430      32528173

RATE OF RETURN                     13.39         -0.33         13.55
```

c. Balance Sheet

Current assets for a team are comprised of cash on hand, loans to others, the value of investments in the national economy, and the value of developments and land. Developments are valued at their typical construction costs times their value ratio divided by 100. Thus, developments that are not maintained decrease in value over time. Land is valued at the fair market value.

Current liabilities is the sum of the principal on all loans from others (indebtedness). Net worth is the difference between current assets and liabilities. Teams may borrow up to 80% of their total assets from national bankers. There are no limits on the amount of debt that teams may have among themselves.

2. Loan Statement (Figure 21)

The loans that a team has with national bankers (outside = OU) and with other teams are shown in the loan statement. The loans received from other sources are listed and their annual payments summarized, and the loans granted to other teams are listed second. Note that the interest rate may vary by loan.

Loans between teams are made for any amount and at whatever interest rate that is mutually agreeable. The only conditions on a loan internal to the system is that the period be specified as either 2 or 25 years, and that the lending team have sufficient cash to cover the loan.

An economic team may also borrow money from the outside system for either a 2 or 25 year period. The interest rate is set by the national bankers who take into consideration the national business cycle. An economic team that has debts equalling 80% of its total assets may not receive any further loans from the outside system.

3. Land Summary (Figure 22)

The land summary output shows the location by parcel coordinates of all land owned by a team. It also shows the assessed value of the parcel (assuming that 100% of the parcel is valued in the same proportion as the private part), the publicly owned part (percent developed and undeveloped), the undevelopable percent, the number of units of utility service available to that parcel, and the actual amount of utility units that are used.

FIGURE 21

```
****************************************************************************************************
                  TWOCITY
              LOAN STATEMENT--ECONOMIC DECISION MAKER A                                    ROUND  1
****************************************************************************************************
                                  INTEREST      REMAINING       ORIGINAL       ANNUAL
      BORROWER      LENDER        RATE          YEARS           PRINCIPAL      PAYMENT
      --------      ------        ---------     ----------      ---------      -------

         A            OU              3.5            24         $  75000000    $  4550592

         A            G               6.2             2         $   3000000    $        0
                                                                               ---------
                                                                     TOTAL     $  4550592


         E            A               6.8             2         $   5000000    $        0

         F            A               7.0             1         $   1890000    $  1045353
                                                                               ---------
                                                                     TOTAL     $  1045353
```

FIGURE 22

```
******************************************************************************************************
                          TWOCITY
                          LAND SUMMARY--ECONOMIC DECISION MAKER  A                                  ROUND  1
******************************************************************************************************
                         PRIVATELY OWNED                PUBLICLY OWNED
                         --------------------------     --------------------------
              ASSESSED                    TAXES ON                                                       UTILITY   CAPACITY
 LOCATION        VALUE   %UNDEVELOPED   UNOEV. LAND    %DEVELOPED   %UNDEVELOPED    %UNDEVELOPABLE    CAPACITY      USED
 --------     --------   ------------   -----------    ----------   ------------    --------------    --------  --------


    70-12   $     1000            100   $        39             0              0                 0         0         0
    72-12   $     1000            100   $        39             0              0                 0         0         0
    70-14   $     1000            100   $        39             0              0                 0         0         0
    72-14   $     1000            100   $        39             0              0                 0         0         0
    86-22   $  6000000             96   $    224640             0              4                 0       100         0
    96-26   $125000000             20   $    875000            24              0                 0      2500       800
    98-26   $ 30000000             80   $    840000            14              6                 0         0         0
    94-28   $136850000             60   $   3202290            20              0                 0       100         0
    96-28   $ 17000000             76   $    452200            24              0                 0         0         0
   110-28   $  8000000             92   $    257600             8              0                 0       100         0
    96-32   $130000000              0   $         0            52              0                 0       700       700
   106-32   $ 15000000             84   $    441000            16              0                 0       100         0
```

Teams may acquire land from other players at mutually agreeable terms or from the computer on a bid submission basis. The computer represents small farmers and otuside land holders who will sell if the price is right. A team's bid will not be processed if it is less than the fair market value of the land. An approximation of fair market value for computer owned land can be made from the Fair Market Value Map. The factors that affect the market value of a parcel of alnd are the location with respect to terminals and residences, the zoning, highway access, and utiltiy service.

The cost of making land bids on computer-owned properties is 2% of the bid amount, regardless of the bid's success or failure.

4. New Construction Table (Figure 23)

The new construction output shows for an economic decision-maker the location at which a new development or an additional level of development is taking place. It also shows the type of development, the old and new level, the location of the local construction industry or 0-0 denoting an outside firm, the contract price, the rent per PL1 (if a residence) or the salary by class (if an employer), the quality index (if housing) or the price per CU (if a store), and the status. "Pending" means that the development will become operational the next round. "Deferred" means that the CI does not have the building capacity to finish on schedule so that the development will not become operational in the next round but at whatever date the CI finishes the job. Deferred contracts have priority next round. "Completed" means that the development became operational at the beginning of the round just completed.

5. Economic Boycott (Figure 24)

Economic teams may boycott the purchase of goods or services from local BG, BS, PG, and/or PS establishments, and their busineses can be boycotted by the social sector as a place to work or shop. Boycotts have effect for the full round, and they continue in operation for succeeding tounds unless terminated by a decision input on the part of the boycotting team. The boycott output shows the team boycotting, the income class or land use that is carrying out the boycott, and the function being boycotted (work or shop). The boycott output also shows the location and land use being boycotted, and the team owning the boycotted business.

Thus, boycott information appears as part of an economic decision-maker's output if he is doing the boycotting and/or if he is being boycotted.

FIGURE 23

```
*****************************************************************************************************************************
                              TWOCITY
                                        NEW CONSTRUCTION TABLE   --  ECONOMIC DECISION MAKER  A                        ROUND 1
*****************************************************************************************************************************

 CONSTRUCTION                                    CONSTRUCTION                          RENT/PLI     QUALITY INDEX
     SITE       LAND     OLD      NEW              INDUSTRY              AGREED           OR              OR
   LOCATION     USE     LEVEL    LEVEL             LOCATION              PRICE         SALARIES        PRICE/CU          STATUS

    96-26        CR       1        2                 0- 0             $250000000      H-$       0                       COMPLETED
                                                                                      M-$       0
                                                                                      L-$       0
```

FIGURE 24

```
**********************************************************************************************************
                       TWOCITY
                  ECONOMIC DECISION MAKER A    BOYCOTT STATUS OUTPUT                              [illegible] 1
**********************************************************************************************************

                                   BOYCOTTING                     BOYCOTTED
                                   ----------                     ---------
                              CLASS OR
                       TEAM   LAND USE    FUNCTION     LOCATION   LAND USE   OWNER
                       ----   --------    --------     --------   --------   -----

                        A     MF          SHOP           9830       BG         C

                        A     FO          SHOP           9830       BG         C
```

6. Residence Detail (Figure 25)

The residence output shows the location, type and level of each residential complex owned by a team. All residences in the model are described as rental units, although the rent on single family housing could be viewed as a form of mortgage payment. Although the construction and operation of housing is a player decision, the process that moves population units into housing is performed by the computer and is affected by player decision in the economic and governmental sectors.

The economic decision-maker directly controls the quality index of housing (by changing the maintenance level) and the rent. Government decision-makers affect the quality of municipal services and schools serving each residence and the tax rate and welfare rate for the jurisdiction containing each residence. All of these factors are taken into consideration by the computer when assigning population units to available housing.

a. The Quality Index and Maintenance Level

The quality index of a residence is a measure of the present value of a development to the best possible value which a residence can have. The social sector master table (page 231) shows the PH's require a quality index of at least 70, PM's a value of 40, and PL's a value of 20. This does not mean, however, that all P1's of a given class automatically move out of housing when the quality index falls below the minimum value. They just won't move in, and they tend to move out because of increased dissatisfaction.

The quality index declines each year in response to time and the quality of local municipal services, unless maintenance is performed on the residence. The maintenance level indicates the lowest level the owner of the residence will allow the quality index to fall before incurring maintenance expenses. The quality index can be raised above its present level by the player inputting a maintenance level that is higher than the quality index. The quality index may not be raised more than 20 points above the lowest level it has ever reached.

b. MS Serving and MS Use Index

As was mentioned in the preceding material, the quality of the municipal services (as measured by the MS use index) serving a residence has an effect on the attractiveness of that residence to potential P1 occupants and on the rate of depreciation (decline in quality index) for that residence. The residence output shows the number of the municipal service building. An index value of 101 or mroe indicates over capacity and means that the municipal services supplied are less than adequate. As the MS use index increases above 101, the residences served by that MS building become less and less attractive to P1's and the residences also depreciate at a faster and faster rate. For example, a use index of 150 is twice as bas as a use index of 125 and five times as bad as a use index of 110.

FIGURE 25

```
******************************************************************************************************
                          TWOCITY
                        ECONOMIC DECISION MAKER B   RESIDENCE OUTPUT                       ROUND  1
******************************************************************************************************

LOCATION                       8826         8828         8830         8834         9234
TYPE AND LEVEL                 RA 3         RA 4         RC 1         RA 3         RB 3
QUALITY INDEX                    82           87           75           80           76
MAINTENANCE LEVEL                80           85           75           80           70
MS DISTRICT                       1            1            1            1            1
UTILITY DISTRICT                  1            1            1            1            1

DEPRECIATION (%)
    MS                          1.0          1.0          1.0          1.0          1.0
    FIRE                        0.0          0.0          0.0          0.0          0.0
    FLOOD                       0.0          0.0          0.0          0.0          0.0

WATER CONSUMPTION (MGD)
    MUNICIPAL                  0.28         0.42         1.20         0.32         1.34
    OUTSIDE                    0.0          0.0          0.0          0.0          0.0

OCCUPANTS                     4M  0H       6M  0H      18M 11H       0M  4H      10M 12H
PERCENT OCCUPANCY               100          113           98          133          108
RENT/SPACE UNIT              161000       159000       161000       160000       161000

 INCOME
    RENT                     966000      1431000      7889000      1280000      6279000

 EXPENDITURES
    MAINTENANCE                   0            0      1229500        88500            0
    UTILITIES                116400       155200      1134900       116400       756600
    WATER                     45360        68040       194400        23040       217080
    PROPERTY TAXES            79170       115867       469617        88398       448503
    INCOME TAXES             442002       658777      3098220       549582      2943720
    SALES TAXES                   0            0        53645         3864            0

NET INCOME                   283068       433116      1708718       410216      1913097

RATE OF RETURN                10.37        11.58         7.81        15.19        12.08

ENVIRONMENTAL INDEXES
   LOW INCOME                   290          284          290          287          290
   MIDDLE INCOME                251          242          261          254          256
   HIGH INCOME                  240          234          250          244          245
```

c. Occupants, Percent Occupancy, and Rent

The residence output shows the number of Pl's of each class that occupy every residence. Ph's and Pl's may never live together on the same residence parcel. The percent of occupancy is determined by taking the number of Pl's by class, multiplying times their residence space consumption index (Social Sector Master Table), and taking this as a ratio of the total space units in the residence. For example, assume an RA3 has one PH and two PMs occupying it. The PH has a space consumption index of 2 and the two PMs together a space consumption index of 2.66 (2 x 1.33). Thus, there are 4.66 space units being occupied from an RA3 that has 6.00 space units of capacity. The occupancy rate is therefore 4.66/6 = .78, or the building is 78 percent occupied.

Rents are always specified in terms of the rent paid per PL unit, which is equivalent to a space unit. A PM pays 1.33 times the per space unit rent, and a PH pays twice as much.

d. Income

The income earned by a residential unit is equal to the rent per space unit times the total number of space unit occupied. In the above example, 4.66 space units were occupied, therefore, at a rent of $150,000 per space unit (per PL) the rental income would be $699.000.

e. Expenditures

The owners of residences incur expenditures for maintenance, utilities, property taxes, income taxes, and sales taxes. The amount of money spent on maintenance is the product of the percent of maintenance times the original value of the building. Assume that the RA3 mentioned above depreciates in value 3% and that the maintenance level was specified such as to offset any depreciation. The cost of maintenance would therefore be .03 x $3,000,000 (the original value of the RA3) = $90,000.

The expenditure for utilities depends upon the number of utility units consumed by type and level of residence (see the Economic Master Table) and the cost per unit of utility service as established by the Utility Department. The typical cost of utility service is $10,000 per unit, and an RA3 consumes 12 units per year, so its utility cost would be $120,000.

Residences pay property tax on the assessed value of the building and the land occupied by the building. The Assessment Department has control over land and building assessments and the Chairman and Council have control over the tax rates which are applied to the assessed value.

Residences pay income taxes on the same basis as all other economic businesses -- a federal tax of 22% on the first $25,000 of net income before taxes and of 48% on the rest of net income and state tax of 5% on net income (after federal income taxes).

Residences pay sales taxes on the purchases from PG and PS for maintenance. The fixed state sales tax is 3% of PG and PS purchases and the local sales tax is whatever rate has been determined by the local sales tax authorities. Sales taxes accrue to the jurisdiction of the commercial establishment and not to the jurisdiction of the residence. State sales taxes are paid on purchases from the outside system as well as from local purchases.

f. Net Income

The final net income for residences is determined by subtracting all of the listed expenditures from the income derived through rents. The net income figure can be compared with the value of the residences and the land they consume to arrive at an estimate of the annual rate of return.

7. Basic Industry Detail (Figure 26)

The basic industry output shows the location, type and level of each basic industry (HI, LI and NS) owned by a team. Basic industry produces units of output that are sold at national markets for per unit prices that are determined by the national business cycle. Owners of basic industry should consult the section of the Demographic and Economic Statistics that show the status of the national economy business cycle.

Basic industry has some characteristics in common with all of the other economic developments. Hence, some of these characteristics have already been described under the residence heading. Other characteristics are peculiar to businesses to basic industry as the following will indicate.

a. Value Ratio and Maintenance Level

Whereas residence quality is represented by the quality index, businesses have their quality represented by the value ratio. The value ratio is the ratio of present value to original value. Businesses depreciate every year in response to time and MS service quality. The Economic Master Table shows the annual percent depreciation caused by time and by MS quality. The way that businesses may overcome this depreciation effect is to set the maintenance level at a point below which they do not want the value ratio to fall. For example, if the maintenance level is set at 100, then the business will make maintenance expenditures every year to keep the building in "like new" shape. The value ratio of a business may be raised above its present value (if less than 100) by inputting a maintenance level that is higher than the value ratio.

FIGURE 26

```
*****************************************************************************************************************************
                                    TWOCITY
                                   ECONOMIC DECISION MAKER A    BASIC INDUSTRY OUTPUT                               ROUND  1
*****************************************************************************************************************************

LOCATION                             9626          9428          9632
CONSTRUCTED LEVEL                    CR 2          MF 1          MP 1
OPERATING LEVEL                      CR 2          MF 0          MP 1
VALUE RATIO                           100           100           100
MAINTENANCE LEVEL                     100           100           100
MS DISTRICT                             3             1             0
UTILITY DISTRICT                        2             1             2
DEPRECIATION (%)
    MS                                3.0           3.0           4.0
    FIRE                              2.5           0.0           3.4
    FLOOD                             0.0           0.0           0.0
    WATER QUALITY                     0.0           0.0           0.0
WATER CONSUMPTION (MGD)
    NORMAL SOURCE                   62.00           0.0           0.0
    OUTSIDE                           0.0           0.0        225.00
PERCENT WATER RECYCLED                  0             0             0
EFFLUENT TREATMENT
    TYPE AND LEVEL                   ST 1             0          ST 1
SALARY (PER WORKER IN 100'S)
    HIGH                              110           110           110
    MIDDLE                             55            55            43
    LOW                                28            28            29
EMPLOYEES
  FULL TIME (IN P1'S)
    HIGH                               48             0            19
    MIDDLE                             48             0            15
    LOW                                28             0            18
  PART TIME (IN UNITS)
    HIGH                              160             0            80
    MIDDLE                            160             0           160
    LOW                               160             0           320
EMPLOYMENT EFFECT                    2000             0           952
UNITS PRODUCED                       2000             0           952
PRICE/UNIT OUTPUT                  197900        250500        190000
INCOME
    SALES(PRIVATE)              395800000             0     180880000
EXPENDITURES
    GOODS                        39000000             0      14000000
    SERVICES                     10000000             0       3500000
    MAINTENANCE                  17340000             0      16100000
    UTILITIES                      880000             0        770000
    WATER
      RECYCLING                         0             0             0
      INTAKE PROCESS              1289600             0             0
      OUTFLOW TREATMENT           1612000             0      11700000
      MUNICIPAL SUPPLY                  0             0      40949984
    TRANSPORTATION               27648734             0      12754497
    SALARIES                    126800000             0      50856000
    PROPERTY TAXES                7450000       1067430       2204800
    SALES TAXES                   1990200             0       1008000
    INCOME TAXES                 97762820             0      47158530
NET INCOME                       66928246      -1067430      32528173

RATE OF RETURN                      13.39         -0.33         13.55
```

b. MS Serving and MS Use Index

As for residences, the value ratio of basic industry is lowered by poor municipal services as measured by an MS use index in excess of 100. Basic industry output shows the number of the municipal service building which serves the basic industry and the use index of the building. The contribution of the MS use index to value ratio decline is directly proportional to the amount by which the use index exceeds 100. For example, a use index of 150 has double the effect of a use index of 125 and five times the effect of a use index of 110.

c. Salary

All businesses must hire employees in order to operate and earn income. Employees' salaries are expressed in terms of wage per worker and not per P1. The normal salary levels are $10,000 for PH, $5,000 forPM, and $2,500 for PL. Since the number of population units hired by an employer is determined by the employment process which takes into account location transportation educational level of workers salary offered and supply of and demand for workers, it is important that employers understand the local labor market situation before setting salary levels.

d. Employees and Employment Effect

The number of population units required for a level one development of all businesses is shown in the Economic Master Table. The number actually hired is shown on the detail business output. Full-time employees are shown in population units (P1's) and part-time employees are shown in time units, where 80 time units equal a P1.

If a basic industry hires all of the employees it requires, the employment effect is 1000 per level of development. A value of less than 1000 means that either some of the full or some of the part-time employees required from some income class were not hired. It is useful to check the Employment Summary and the Part-time Employment Statistics if deficiency of employees exists. If a basic industry at level one hires only 80 percent of the P1's it requires, then the employment effect is 800 (i.e., 1000 x .80).

e. Units Produced

The maximum units produced by a basic industry is 1000 per level. If the employment effect is less than 1000 and if the value ratio is less than 100 then the units produced will not be at a maximum. The units produced figure is obtained by multiplying the employment effect by VR/100. Thus, if the employment effect were 800 and the value ratio were 90, then the units produced would be 720 (i.e., 800 x .90).

f. Price per Unit of Output and Income

The price per unit of output for basic industry is determined by the national business cycle, and the normal price per unit for the industry type. The actual price per unit of output is the normal price multiplied by the business cycle factor. Income is the product of the price per unit and the units produced. All sales of basic industry output are to the national system.

g. Expenditures

Basic industry incurs expenses for business goods and business services. A fixed amount of BG and BS units are purchased by basic industry by type and level for normal operation. Basic industry also purchases BG and BS units in direct proportion to the amount of maintenance performed, and these expenditures are listed separately under the maintenance category.

The expenditure for utilities depends upon the number of utility units consumed by basic industry by type and level (see the Economic Master Table) and price per utility unit being charged by the Utility Department. Typical utility prices are $10,000 per unit. At these prices, an CR1 would spend $4,000,000 on utilities per year.

Basic industry pays transportation to BG and BS if the industry purchases these from the local system. The transportation charges are based on the type and level of industry and the least cost distances along the various types of roads. HI and LI also incur transportation costs to the terminal which represents the cost of shipping the units produced to national markets. The transportation costs to BG, BS and the terminal are independent of the number of units purchased or produced. The costs are solely a function of type of industry, level, distance travelled to destination and type of roads.

Salary costs by class are determined by multiplying the salary per worker times the number of workers per P1 times the number of P1's hired. The normal salaries are $1,200,000 for a PH1, $800,000 for a PM1, and $500,000 for a PL1, since the three classes of population have 120, 160 and 200 workers respectively per p1.

Businesses pay property tax on the assessed value of the development and the land occupied by the development. The Assessment Department assesses the value of land and developments and the Chairman and Council determine the tax rates to be applied to the assessed values of developments and of land.

Businesses pay income taxes in the same manner as residences -- a federal tax of 22% on the first $25,000 of net income before taxes, a federal tax of 48% on the remainder and a state tax of 5% on net income after federal taxes have been deducted.

Businesses pay sales taxes on the purchases from BG and BS. There is a fixed state sales tax of 3% and the local sales tax can be changed by the local taxing authority. Sales tax revenue accrues to the jurisdiction of the seller rather than to the jurisdiction of they buyer. State sales taxes are paid on purchases from the otuside system as well as on local purchases.

h. Income

Basic industry net income is obtained by subtracting all of the above expenditures from the gross income. By comparing the net income of a basic industry with the market value of its building and land, the owner may develop an annual rate of return figure for the industry.

8. Commercial Establishment Detail (Figure 27)

The computer output for commercial establishments is slightly different for business commercial (BG and BS) and for personal commercial (PG and PS). The major difference is that BG and BS always purchase their needed supplies from the outside system, whereas PG and PS are able to purchase their goods and services from local BG and BS establishments.

The commercial output shows the location, type and level of development. The interpretation of value ratio is the same as for basic industry, with the addition that the number of customers served above a certain point contributes to an increase in the depreciation. This depreciation due to use occurs when the capacity use by the commercial establishment exceeds the effective capacity.

Maintenance level, MS serving, MS use index, salary, employees, and employment effect have the same explanation for commercial establishments as for basic industry as described in the previous section.

a. Capacity Used and Effective Capacity

The effective capacity is calculated for commercial establishments in the same way units produced are calculated for basic industry -- the employment effect timve value ratio divided by 100. The effective capacity indicates the numebr of capacity units (CU's) that the commercial establishment can supply to its customers without a strain on plant and equipment.

FIGURE 27

```
*****************************************************************************************************************
                                   TWOCITY
                                   ECONOMIC DECISION MAKER B    COMMERCIAL OUTPUT                      ROUND  1
*****************************************************************************************************************

LOCATION                           9832
TYPE AND LEVEL                     BS 1
VALUE RATIO                          83
MAINTENANCE LEVEL                    80
MS DISTRICT                           0
UTILITY DISTRICT                      5
DEPRECIATION (%)
    MS                              3.0
    FIRE                            2.0
    FLOOD                           0.0
    USE                             0.0
WATER CONSUMPTION (MGD)
    MUNICIPAL                      0.0
    OUTSIDE                        0.17
SALARY (PER WORKER IN 100'S)
    HIGH                            100
    MIDDLE                           50
    LOW                              25
EMPLOYEES
  FULL TIME (IN PI'S)
    HIGH                             20
    MIDDLE                            9
    LOW                               0
  PART TIME (IN UNITS)
    HIGH                             80
    MIDDLE                            0
    LOW                               0
EMPLOYMENT EFFECT                  1154
CAPACITY USED                       913
EFFECTIVE CAPACITY                  958
PRICE/CU                         100000


INCOME
    SALES(PRIVATE)             91200000
    SALES(PUBLIC)                100000


EXPENDITURES
    SERVICE CHARGES            52954000
    MAINTENANCE                       0
    UTILITIES                     78100
    WATER                         36890
    TRANSPORTATION                    0
    SALARIES                   32400000
    PROPERTY TAXES               231850
    SALES TAXES                 1588620
    INCOME TAXES                2080920
NET INCOME                      1966510

RATE OF RETURN                    23.69
```

Capacity used is the number of CU's that the commercial establishment actually sold to customers in the local market as decided by the commercial process. If the capacity used exceeds the effective capacity, then the commercial establishment undergoes a strain on its plant and equipment that is represented by increased depreciation of the physical facilities. BG and BS establishments may sign contracts with local government departments (Schools and Municipal Services) to automatically supply these departments with their needed goods and services. If these two government departments do not make a contract with a local firm, they will purchase from the outside system at greater than normal prices per unit. These government departments can specify a contract with more than one local establishment by indicating the percentage of purchases from each establishment and the priority (the one they most want to purchase from) to each establishment. Greater detail on these contracts is given under the description of the government sector.

b. Price per Capacity Unit (CU)

Unlike basic industry which has its prices determined by the business cycle, each commercial establishment sets its own price. Factors that must be taken into account when setting the price are location in relation to potential workers, buyers and sellers, competitive establishments, local demand, boycotts, and the typical price. Typical prices are listed in the Economic Master Table.

The Commercial Process assigns customers to commercial establishments on the basis of least cost of the CU including the customer's transportation cost to get to the commercial establishment. Customers also are given a bias to shop where they shopped the previous year and a bias against shopping at over-crowded establishments.

Owners of commercial establishments are encouraged to examine the commercial allocation summary output to see which stores are serving which customers. A detail description of this otuput can be found under the General Output Section.

c. Income

Sales to private customers and sales to public customers are separated for BG and BS, but not for PG and PS since the latter establishments only sell to the private sector. Income is the product of capacity used and price per CU.

d. Expenditures

BG and BS spend money for service charges which represent purchases from the outside system. PG and PS spend money for business goods and services that they require in order to operate. In both cases, the dollar amount of expenditures for goods and services (service charges) is directly related to the number of capacity units sold. These relationships are shown in the Economic Master Table.

Commercial establishments must pay annual maintenance if the value ratio is to be prevented from declining. BG and BS pay their maintenance to the outside system, whereas PG and PS purchase units of BG and BS for the purposes of maintenance. These relationships are also shown in the Economic Master Table along with the factors that cause depreciation. Remember that overcrowding of commercial establishments causes the depreciation rate to increase.

Commercial establishments purchase utilities based upon type and level of development as indicated in the Economic Master Table. The typical price per utility unit is $10,000, but this may vary in response to local Utility Department circumstances.

PG and PS have transportation charges to BG and BS if they purchase locally, BG has transportation to terminal to purchase goods from the outside system, and BS has no transportation charges. The transportation costs by type of road to the several destinations are given in the Economic Master Table.

Salary payments are calculated for each income class on the same basis as for basic industry -- the wage per worker times the number of workers per P1 times the number of P1's employed. Likewise, taxes are calculated in the same manner as for residences and basic industry. Sales taxes are paid to the jurisdiction where the seller is located, and purchases from the outside are taxed at the same state tax rate as local purchases.

e. Net Income

The net income of commercial establishments is calculated in the same fashion as for residences and basic industry -- income minus expenditures. Net income for commercial establishments can be very volatile because of the competitive aspect of the local market and the control over pricing, so the calculation of rates of return by comparing net income with the value of the development and land becomes even more important for these activities.

9. Farming Activity Detail (Figure 28)

Each farm with its group of parcels and the percent of land under farming is listed with their individual fertilizer levels.

The incomes before and after fertilizing are shown as normal and actual income before taxes for one percent of farm land. This is then multiplied by the total number of percents in the farm to provide the actual gross income of the farm. The total net income is the gross income less the land taxes.

H. Social Decision-Maker Output

1. Population Detail (Figure 29a)

This output summarizes the social and eocnomic status for each population unit which a social decision-maker controls. The income class of the population units are indicated at the top of the form. The following items are indicated:

a. Location - the location of the residence at which the population units live. This residence is owned by an economic decision-maker. (See Economic Status Map)

b. Number of P1's - the number of population units of that particular class living at the location. Remember, there are 500 people in a population unit.

c. Education Level - ranges from 0-39 for P1, 40-69 for PM, and 70-99 for PH and determines the ability of a P1 to get a good job.

d. Voter Registration - number of voters registered for each population unit of each class. Normal registered voters are 100 for PL, 140 for PM and 200 for PH.

e. Dissatisfaction Index - the total amount of dissatisfaction resulting form residential and personal dissatisfaction. P1's with the highest dissatisfaction indices will migrate out of the city and seek better jobs, housing, etc.

f. Previous Savings - total savings (i.e., unspent funds) from preceding rounds.

g. Income - income form full-time employment, part-time employment and (for unemployed) welfare payments specified by the Chairman.

h. Expenditures - total amount of expenditures for rent, transportation (by auto, bus or rail), purchases of goods and services, private schools and taxes.

FIGURE 28

```
*************************************************************************************************************************
                          TWOCITY
                   ECONOMIC DECISION-MAKER A    FARM OUTPUT                                                    ROUND  1
*************************************************************************************************************************

 FARM              NUMBER      NUMBER                   NORMAL INCOME   INCOME MULTIPLIER     ACTUAL INCOME
 CODE     FARM       OF          OF       FERTILIZER    BEFORE TAXES    FERTILIZER LEVEL:     BEFORE TAXES     TOTAL LAND     TOTAL
NUMBER    TYPE     PARCELS    PERCENTS      LEVEL       (PER 1% UNIT)     1     2     3       (PER 1% UNIT)    TAX PAID     NET INCOME
------    ----     -------    --------    ----------    -------------   ----- ----- -----     -------------    ----------   ----------

  1        F1         6         504           3              1000        1.07  1.12  1.20          1199           12094        592705

  2        F2         5         462           1              1000        1.08  1.16  1.25          1079            9978        488981

  3        F3         3         300           3              1000        1.05  1.09  1.15          1149            6899        338101
```

FIGURE 29a

```
***********************************************************************************************************************
                  TWOCITY
              SOCIAL DECISION MAKER CC      HIGH  SOCIO-ECONOMIC CLASS                        JURISDICTION 2        ROUND  1
***********************************************************************************************************************

LOCATION                              9236      9436      9238      9438      9638      9838
NUMBER OF P1'S                           3        12         1         3         4         3
EDUCATION LEVEL                         79        90        90        91        92        93
VOTER REGISTRATION PER P1              216       216       216       216       216       216
PREVIOUS SAVINGS PER P1                  0         0         0         0         0         0
PERCENT OF P1'S UNEMPLOYED               0         0         0         0         0         0

INCOME PER P1
    EMPLOYMENT(FULL)                660000   1290000   1320000   1320000   1320000   1320000
    EMPLOYMENT(PART)                     0    164999    165000    157500    157500    165000
    WELFARE                              0         0         0         0         0         0
    MISCELLANEOUS                        0         0         0         0         0         0

EXPENDITURES PER P1
    RENT                            280000    302000    334000    270000    312000    308000
    TRANSPORTATION
       AUTO                         137158    100162    152675    124241    124350    134616
       BUS                               0         0         0         0         0         0
       RAIL                              0         0         0         0         0         0
    GOODS                           346500    346500    346500    346500    346500    346500
    SERVICES                        161666    162475    164900    161666    162475    161666
    SCHOOL (CHILDREN)                21400     21450     21300     21400     21450     21400
    SCHOOL (ADULTS)                      0         0         0         0         0         0
    HEALTH                            8000      8000      8000      8000      8000      8000
    SALES TAX                        22174     22210     22321     22174     22211     22174
    INCOME TAX                       21120    145230    151470    150705    150705    151470
    AUTOMOBILE TAXES                  1404      1011      1704      1404      1404      1224
    MISCELLANEOUS                        0         0         0         0         0         0

SAVINGS PER P1                     -339422    345961    282130    371410    328405    329950
NEW BALANCE PER P1                 -339422    345961    282130    371410    328405    329950


TIME ALLOCATION PER P1

     TRANSPORTATION                     15        11        20        15        15        15
     ILLNESS                             2         3         0         0         0         0
     EXTRA JOB (40)                      0        10        10        10        10        10
     EDUCATION
        PUBLIC ( 0)                      0         0         0         0         0         0
        PRIVATE ( 0)                     0         0         0         0         0         0
     POLITICS (25)                      25        25        25        25        25        25
     RECREATION (10)                    10        10        10        10        10        10
     INVOLUNTARY                        48        41        35        40        40        40

HEALTH INDEX                            16        25         0         0         0         0
PERSONAL INDEX                          16        25         0         0         0         0
NEIGHBORHOOD INDEX                     233       233       240       233       233       233
ENVIRONMENTAL INDEX                    233       233       240       233       233       233
QUALITY OF LIFE INDEX                  249       258       240       233       233       233
```

i. Savings - amount of income not spent this round.

j. New Balance - current savings plus previous savings.

k. Time Allocation (requested) - in parentheses is the amount of time units requested to be allocated to various activities, either jurisdiction-wide or for a particular parcel. In the columns is the amount of time actually spent in these activities as listed, with the amount of time spent traveling to and from work. Time spent traveling to and from work cuts into time available for allocation.

l. Involuntary Time - the total number of time units which were allocated for a particular activity but were unable to be spent in that activity. Involuntary time affects dissatisfaction.

m. Dollar Value of Time Unit Traveling - the dollar value (set by social decision-maker) of a population unit's time spent going to and from work. Normal values are $25 for PL, $50 for PM, and $100 for PH. Dollar value of time is the criteria which the computer considers when assigning a mode of transportation (bus, rail, or auto) to work.

2. Boycott Status (Figure 29b)

This output shows for the social decision-maker which of the population units he controls are boycotting various work or shop locations and/or the bus or rail modes of transportation. All boycotts remain in effect until a decision is made to stop them.

I. Government Output

1. Government Financial Summary (Chairman and Council) (Figure 30)

This output summarizes the current and capital expenditures of each municipal department in the city in addition to providing a statement of the Chairman and Council's total revenues (from taxes and bonds) and expenditures (for appropriations to the department, subsidies and bond payments).

2. Tax Summary (Chairman and Council) (Figure 31)

The tax summary indicates the revenue from various taxes in each jurisdiction. It is given to the Chairman and provides a basis for computing tax rates in future rounds.

FIGURE 29b

```
****************************************************************************************************
                                   TWOCITY
                          SOCIAL DECISION MAKER CC   BOYCOTT STATUS OUTPUT                                     ROUND  1
****************************************************************************************************


                                         BOYCOTTING                          BUYCUTTED
                                         ----------                          ---------
                                  CLASS OR
                           TEAM   LAND USE     FUNCTION          LOCATION    LAND USE    OWNER
                           ----   --------     --------          --------    --------    -----

                            CC      HIGH         WORK                                      SC1
```

FIGURE 30

```
*****************************************************************************************************************************
                    TWOCITY
                              CHAIRMAN DEPARTMENT FINANCES                              JURISDICTION 1        ROUND 1
*****************************************************************************************************************************

WELFARE PAYMENT PER UNEMPLOYED WORKER IS 1700.


                              MUNICIPAL SERVICES
                              ------------------

          CAPITAL                                   CURRENT
          -------                                   -------

  PREVIOUS CASH BALANCE               0.     PREVIOUS CASH BALANCE            0.

  REVENUES                                   REVENUES
      APPROPRIATIONS                  0.       APPROPRIATIONS          10000000.
      BONDING                   7500000.       FED/STATE AID                  0.
      MISC. INCOME            110000000.       BONDING                  8550000.
                                               MISC. INCOME                   0.
                               --------                                 -------
  TOTAL                       117500000.     TOTAL                     18550000.

  EXPENDITURES                               EXPENDITURES
      CONSTRUCTION              6000000.       BOND PAYMENTS             472080.
      LAND PURCHASE                6000.       GOODS + SERVICES         1180000.
      MISCELLANEOUS                   0.       MISCELLANEOUS                  0.
                                               SALARIES                16896000.
                                               WELFARE PAYMENTS               0.

                               --------                                 -------
  TOTAL                         6006000.     TOTAL                     18548080.

  NEW CASH BALANCE            111494000.     NEW CASH BALANCE              1920.

 ----------------------------------------------------------------------------------
 ----------------------------------------------------------------------------------


                                   SCHOOLS
                                   -------

          CAPITAL                                   CURRENT
          -------                                   -------

  PREVIOUS CASH BALANCE               0.     PREVIOUS CASH BALANCE            0.

  REVENUES                                   REVENUES
      APPROPRIATIONS                  0.       APPROPRIATIONS          17000000.
      BONDING                         0.       FED/STATE AID            1228500.
      MISC. INCOME            150000000.       BONDING                  7700000.
      FED/STATE AID                   0.       MISC. INCOME             1600000.

                               --------                                 -------
  TOTAL                       150000000.     TOTAL                     22528500.

  EXPENDITURES                               EXPENDITURES
      CONSTRUCTION                    0.       BOND PAYMENTS             826013.
      LAND PURCHASE                   0.       GOODS + SERVICES         2500000.
      MISCELLANEOUS                   0.       MISCELLANEOUS                  0.
                                               SALARIES                14868000.
                                               ADULT EDUCATION          4325400.

                               --------                                 -------
  TOTAL                               0.     TOTAL                     22519413.

  NEW CASH BALANCE            150000000.     NEW CASH BALANCE              9087.

 ----------------------------------------------------------------------------------
 ----------------------------------------------------------------------------------


                                   HIGHWAYS
                                   --------

          CAPITAL                                   CURRENT
          -------                                   -------

  PREVIOUS CASH BALANCE              -8.     PREVIOUS CASH BALANCE            0.

  REVENUES                                   REVENUES
      APPROPRIATIONS                  0.       APPROPRIATIONS            500000.
      BONDING                         0.       BONDING                   220000.
      MISC. INCOME            250018000.       MISC. INCOME             4000000.
      FED/STATE AID                   0.
                               --------                                 -------
  TOTAL                       250018000.     TOTAL                      4720000.

  EXPENDITURES                               EXPENDITURES
      ROAD CONSTRUCTION         2000000.       MAINTENANCE              3955557.
      TERM. CONSTRUCTION              0.       BOND PAYMENTS             354766.
      LAND PURCHASE                   0.
      MISCELLANEOUS               17000.       MISCELLANEOUS             400000.

                               --------                                 -------
  TOTAL                         2017000.     TOTAL                      4710323.

  NEW CASH BALANCE            248000992.     NEW CASH BALANCE              9677.

 ----------------------------------------------------------------------------------
 ----------------------------------------------------------------------------------
```

FIGURE 30 Continued

```
                    PLANNING AND ZONING
                    -------------------

                          CAPITAL
                          -------

               PREVIOUS CASH BALANCE              0.
               REVENUES
                    APPROPRIATIONS          2000000.
                    BONDING                       0.
                    MISC. INCOME                  0.

                                            -------
               TOTAL                        2000000.

               EXPENDITURES
                    PUBLIC INSTITUTIONS           0.
                    LAND PURCHASE                 0.
                    BOND PAYMENTS                 0.
                    MISCELLANEOUS                 0.

                                            -------
               TOTAL                              0.

               NEW CASH BALANCE             2000000.

------------------------------------------------------------------------
------------------------------------------------------------------------

                          UTILITIES
                          ---------

         CAPITAL                                  CURRENT
         -------                                  -------

PREVIOUS CASH BALANCE              0.   PREVIOUS CASH BALANCE              0.

REVENUES                                REVENUES
    SUBSIDIES                      0.     SUBSIDIES                        0.
    BONDING                        0.     BONDING                    4680000.
    MISC. INCOME           270000000.     MISC. INCOME                     0.
                                          UTILITY USERS             13871000.
                                          WATER USERS                2026979.

                             -------                                 -------
TOTAL                      270000000.   TOTAL                       20577979.

EXPENDITURES                            EXPENDITURES
    UTILITY PLANT CONSTR.   30000000.     UTILITY OPERATION         16511110.
    TREATMENT PLANT CONSTR.  9599999.     TREATMENT OPERATION        2392742.
    MISCELLANEOUS                  0.     SAMPLING STATIONS           700000.
    EXTENSION OF SERVICE           0.     MISCELLANEOUS                    0.

    LAND PURCHASE              25000.     BOND PAYMENTS               970366.

                             -------                                 -------
TOTAL                       39624999.   TOTAL                       20574218.

NEW CASH BALANCE           230375001.   NEW CASH BALANCE                3761.

------------------------------------------------------------------------
------------------------------------------------------------------------

                    CHAIRMAN'S ACCOUNTING
                    ---------------------

                          CURRENT
                          -------

               PREVIOUS CASH BALANCE              0.
               REVENUES
                  TAXES                    51869360.
                  NEW BONDING                     0.
                  MISCELLANEOUS                   0.

                                            -------
               TOTAL                       51869360.

               EXPENDITURES
                  APPROPRIATIONS           24500000.
                  SUBSIDIES                     300.
                  BOND PAYMENTS                   0.
                  MISCELLANEOUS                 180.

                                            -------
               TOTAL                       24500480.

               NEW CASH BALANCE            27368880.

------------------------------------------------------------------------
------------------------------------------------------------------------

THERE ARE NO OUTSTANDING BONDS
```

FIGURE 31

```
****************************************************************************************************
        TWOCITY
                          T A X   S U M M A R Y                              JURISDICTION 1     ROUND  1
****************************************************************************************************

ITEM                                   BASE             RATE          REVENUE

PROPERTY TAX LAND               $    691867904.    3.9 PERCENT    $    26982848.
             IMPROVEMENT        $    137732000.    4.0 PERCENT    $     5509280.
RESIDENT INCOME TAX             $    538540032.    3.0 PERCENT    $    16156200.
EMPLOYEE INCOME TAX             $    160110928.    0.0 PERCENT    $           0.
RESIDENT AUTOMOBILE TAX         $     36430272.    1.0 PERCENT    $      364303.
EMPLOYEE AUTOMOBILE TAX         $      7571200.    0.0 PERCENT    $           0.
GOODS SALES TAX                 $    149341104.    1.3 PERCENT    $     1941434.
SERVICES SALES TAX              $     61022352.    1.5 PERCENT    $      915336.

TOTAL REVENUE                                                   $    51869360.
```

3. Financial Summary (Public Information) (Figure 32)

A gross summary of the government accounts for the general public is given for each department of each jurisdiction.

4. Assessment Factors (Figure 33)

The first portion of this output shows, for each jurisdiction, the assessment rate for all land -- either developed or undeveloped (UL) -- and the assessment rate for all developments. Assessment rates are applied to the market value of land and developments.

The second section prints only if there were assessment decisions during the previous round. This portion lists the assessment factors for each zone and the location and value of any special assessments. Any assessment input errors are also listed here.

5. School Department Detail (Figure 34)

This output shows the status of the School Department for each jurisdiction. It gives the following information:

a. School Units - the numerical designation, development level, location, maintenance level, and value ratio of each school; the number of students (by class) at each school; the number of teachers at each school (by class); the student/teacher ratio at each school; and the use index of each school. (Remember, as the use index increases above 100, the school is being overused.)

b. Undeveloped land - indicates the amount and location of all undeveloped land which the School Department owns.

c. Contracts - the location and owner of BG and BS establishments with which the School Department has contracts. This section also indicates the price paid per capacity unit of BG and BS, the amount of capacity units, and the amount of goods and services bought from the outside system.

d. Bonds - the number, type, remaining term and annual payment on bonds which the department has outstanding.

e. Adult Education - the amount of part-time employment requested and obtained, the actual and used capacity, and unmet demand for adult education.

f. Financial Accounting - the current and capital revenues and expenditures of the department in addition to the amount of federal/state aid available for construction. (Figure 35)

g. New Construction - this table appears only when a new school is built in the current round. It provides information on the location, price, levels of development and maintenance, the employment mix and the builders. "Outside" indicates that an outside construction firm did the construction. (Figure 36)

FIGURE 32

```
**********************************************************************************************************
                    TWOCITY
              F I N A N C I A L   S U M M A R Y                                JURISDICTION 1      ROUND  1
**********************************************************************************************************

                         APPROPRIATIONS            FEDERAL        OTHER         TOTAL        TOTAL       SURPLUS
                                                                                                           OR
      DEPARTMENT      CAPITAL      CURRENT       STATE  AID      INCOME       REVENUE      EXPENSES      DEFICIT

MUNICIPAL SERVICES          0     10000000              0     126050000     137545920     134554080      2991840

SCHOOL DEPARTMENT           0     12000000        1228500     157700000     170937587     168194013      2743574

HIGHWAY DEPARTMENT          0       500000              0     250238000     248730669     256345323     -7614654

PLANNING AND ZONING   2000000            0              0             0       4006000             0      4006000

CHAIRMAN                    0     24500000              0           300      51869180             0     51869180

    TOTAL             2000000     47000000        1228500     533988300     613089356     559093416     53995940
```

FIGURE 33

```
..........................................................................................................
                              TWOCITY
                         ASSESSMENT REPORT                                        JURISDICTION 1      PAGE 1
..........................................................................................................

     ASSESSMENT RATIOS  (PERCENT OF MARKET VALUE)
     ---------------------------------------------

      LAND ON UNDEVELOPED PARCELS           50.0
      LAND ON DEVELOPED PARCELS             35.0


        BUSINESS TYPE:          RA          50.0
                                RB          50.0
                                RC          50.0
                                LI          50.0
                                HI          50.0
                                NS          50.0
                                CI          10.0
                                BG          50.0
                                BS          50.0
                                PG          50.0
                                PS          50.0
          FARM TYPE:            F1          15.0
                                F2          15.0
                                F3          15.0


     EXCEPTIONS TO JURISDICTION-WIDE RATIOS
     --------------------------------------
                    LOCATION    RATIO (%)
                    --------    ---------

      DEVELOPMENT:    NONE

      NON-FARM LAND:
                      B822       30.0

      FARM LAND:      NONE

      DOLLAR VALUE
       BUILDING:      NONE

      DOLLAR VALUE
       LAND:          NONE


      DOLLAR VALUE
       FARM:          NONE
```

FIGURE 34

```
**********************************************************************************************
                    TWOCITY        SCHOOL DEPARTMENT REPORT           JURISDICTION 1      ROUND 1
**********************************************************************************************

S C H O O L   U N I T S
------------------------

                                                    S T U D E N T S
                            MAINTENANCE   VALUE   --------------------   TEACHERS REQUESTED   STUDENT/TEACHER
SCHOOL  LOCATION LEVEL         LEVEL      RATIO    HIGH   MIDDLE   LOW     HIGH    MIDDLE         RATIO        USE INDEX
--------------------------------------------------------------------------------------------------------------------------

   1      9030     1            90          93       0       0      0        2       3              0               0
   2      9032     1            90          93       0    5460      0        5       4              4              22


UNDEVELOPED LAND
----------------
       LOCATION   AMOUNT     LOCATION   AMOUNT
       --------   ------     --------   ------
         90-30      10         90-32      10

C O N T R A C T S

-----------------
                           PERCENTAGE   OF    COST PER       CAPACITY        TOTAL
 TYPE   OWNER   LOCATION   TOTAL PURCHASES       UNIT        UNITS USED      COST

---------------------------------------------------------------------------------------------

 BG       C      98- 30          70            100000           11          1100000
 BG    OUTSIDE                   30            130000            5           650000
 BS       B      98- 32          30            100000            1           100000
 BS    OUTSIDE                   70            130000            5           650000
                                                                            2500000


    A D U L T   E D U C A T I O N
    -----------------------------
    EMPLOYMENT REQUESTED       EMPLOYMENT OBTAINED


    ----------------------------------------------
    HIGH      MIDDLE        HIGH      MIDDLE      ACTUAL CAPACITY     USED CAPACITY      UNMET DEMAND

  ---------------------------------------------------------------------------------------------

    180       138           180       138             4080               3330               0


 SCHOOL AGE POPULATION IS                            34040
 NUMBER OF STUDENTS ATTENDING LOCAL SCHOOLS           5460
 NUMBER OF STUDENTS ATTENDING PRIVATE  SCHOOLS       28580
 SALARY OFFERED HIGH INCOME TEACHERS                 10500
 SALARY OFFERED MIDDLE INCOME TEACHERS                5400
```

FIGURE 35

```
***************************************************************************************************************
                              TWOCITY
                                       SCHOOL DEPARTMENT FINANCES                          JURISDICTION 1      ROUND  1
***************************************************************************************************************


                  CAPITAL                                               CURRENT

REVENUES                                               REVENUES


PREVIOUS CASH BALANCE                  0               PREVIOUS CASH BALANCE                  0
APPROPRIATIONS                         0               APPROPRIATIONS                  12000000
FEDERAL-STATE AID USED                 0               FEDERAL-STATE AIO USED           1228500
NEW BONDS                              0               NEW BONDS                        7700000
MISCELLANEOUS                  150000000               MISCELLANEOUS                    1600000
                              ----------                                             ----------
        TOTAL                  150000000                                               22528500


EXPENOITURES                                           EXPENOITURES

SCHOOL CONSTRUCTION                    0               GOODS ANO SERVICES               2500000
LAND PURCHASES                         0               FULL-TIME SALARIES              14868000
MISCELLANEOUS                          0               MISCELLANEOUS                          0
                                                       BONO PAYMENTS                     826013
                                                       ADULT EOUCATION                  4325400
                              ----------                                             ----------
        TOTAL                          0                                               22519413


CURRENT BALANCE                150000000               CURRENT BALANCE                     9087



                          OUTSTANDING BONDS
                          -----------------


      TYPE           ORIGINAL      REMAINING     INTEREST        ANNUAL
                     PRINCIPAL        TERM          RATE         PAYMENT
      ----           ---------     ---------     --------        -------

     CAPITAL         12000000.       14             4.7           826013.
     CURRENT          7700000.        2             3.3          4041654.
```

FIGURE 36

```
****************************************************************************************************************************
                                           TWOCITY
                                                   SCHOOL  DEPARTMENT CONSTRUCTION TABLE                    JURISDICTION 1      ROUND  1
****************************************************************************************************************************
CONSTRUCTION       SITE                      OLD           NEW            AGREED             MAINTENANCE    EMPLOYMENT
    FIRM         LOCATION      STATUS       LEVEL         LEVEL            PRICE                LEVEL        LOW   MID.
************     ********      ******       *****         *****         **********           ***********    *****  *****

      0             9032       COMPLETED       2             1            6000000                 0            0      0
```

6. School Map (Figure 37)

This map shows the location of all schools in the city (indicated by "SC") and the districts which each school serves marked by XXX). For each parcel with a residence on it, it also shows the number of students (in 100's) attending the school (upper number) and the number of students (in 100's) going to schools outside the system (lower number).

7. Municipal Services Map (Figure 38)

This map shows the location of all municipal service plants (the parcels surrounded by asterisks). The parcels that receive service from these municipal services are identified with the number of the MS unit. For example, a parcel with "1" on it is serviced by the number 1 MS unit (the parcel surrounded by asterisks with the number "1" inside).

8. Municipal Services Detail (Figure 39)

This output summarizes the status of the Municipal Services Department and shows the following items:

a. MS Characteristics - the numerical designation location, development level, maintenance level and value ratio of each MS plant. In addition, this section of output indicates the effective capacity of service, the loading (actual service drained), the employment, and the MS use index of each plant (use index will always be greater than 100 when loading is greater than effective capacity), the salary paid each MS worker, and the welfare payments to each unemployed worker in the jurisdiction.

b. Contracts - the owner, location and cost of BG and BS purchases from within the local system as well as contracts (if any) for goods and services from tht outside system.

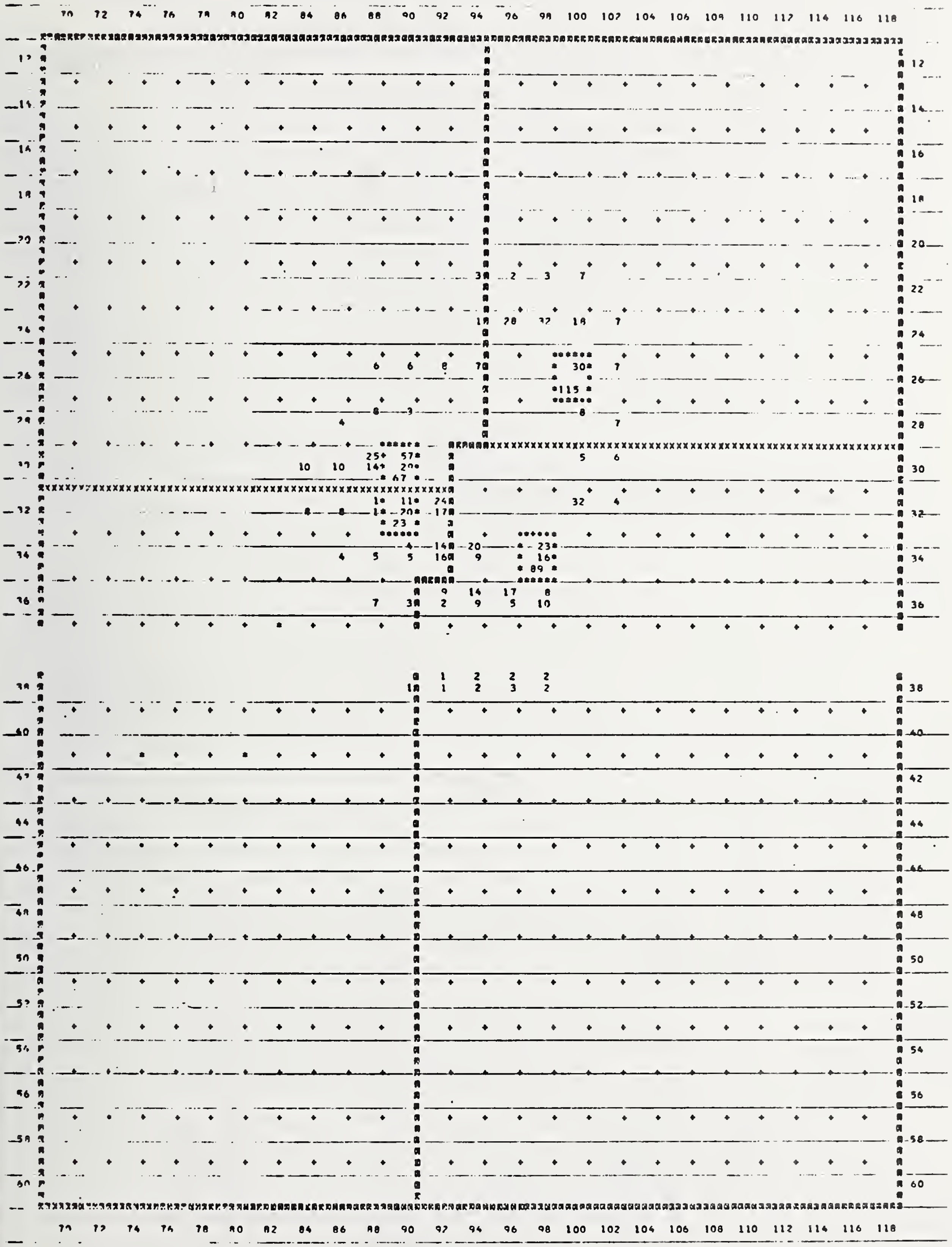
c. Outstanding Bonds - the number of outstanding bonds, their remaining term, the interest rate, annual payment and principal.

d. Financial Accounting - the current and capital expenditures and revenues of the department. (Figure 40)

e. New constructions are also presented if the construction occurred in the current round. (Figure 41)

FIGURE 37

```
TWO CITY--HOWARD UNIVERSITY URBAN SYSTEMS ENGINEERING PROGRAM.
SCHOOL MAP                                                    ROUND 1
```

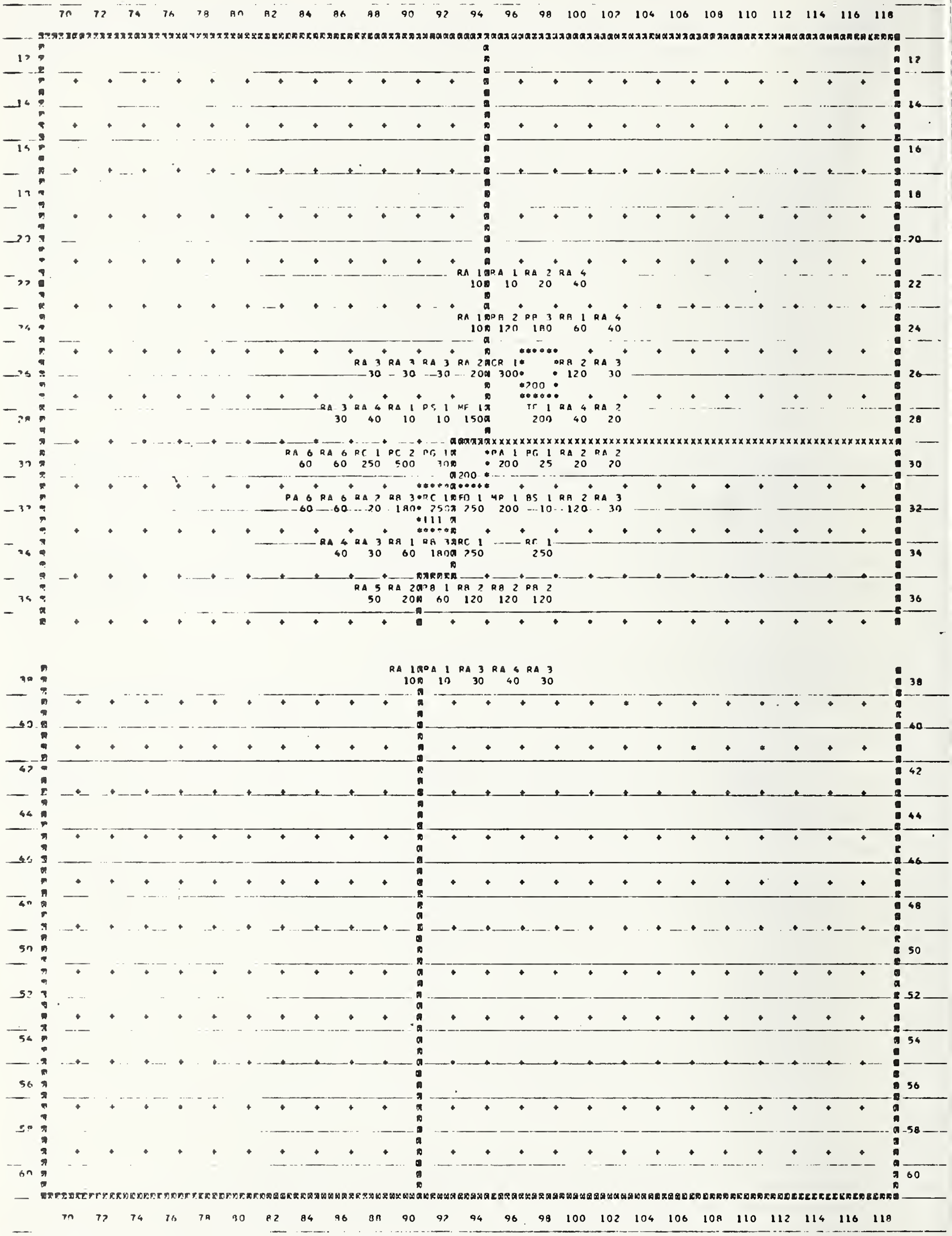


```
PARCELS                                    PARCEL EDGES
TOP ROW:    PUB SCHL STDNTS                XX DISTRICT BOUNDARY
MIDDLE ROW: PRV SCHL STDNTS                OO JURISDICTION BOUNDARY
BOTTOM ROW: SCHL USE INDEX                 ## BOTH
        (IF SCHL ON PARCEL)                ** SCHOOL ON PARCEL
   NUMBER OF STUDENTS IN 100'S
```

FIGURE 38

TWO CITY--HOWARD UNIVERSITY [illegible] MS ENGINEERING PROGRAM.
MUNICIPAL SERVICE MAP

ROUND - 1



PARCELS
TOP ROW: LAND USE AND LEVEL
MIDDLE ROW: MS UNITS DRAINED
BOTTOM ROW: MS USE INDEX
(IF MS ON PARCEL)

PARCEL EDGES
XX DISTRICT BOUNDARY
OO JURISDICTION BOUNDARY
RR BOTH
** MS ON PARCEL

FIGURE 39

```
**********************************************************************************************************************************
                                TWOCITY
                                MUNICIPAL SERVICES DEPARTMENT REPORT                                  JURISDICTION 1         RUNNO  1
**********************************************************************************************************************************
                         MAINTENANCE     VALUE    EFFECTIVE CAPACITY                   EMPLOYMENT     M.S. USE
MS  LOCATION    LEVEL       LEVEL        RATIO       OF SERVICE          LOADING     LOW    MIDDLE          INDEX
------------------------------------------------------------------------------------------------------------------------

 1    92-32       1          45            91           1738              2460        12      12          142

TOTALS                                                  1738              2460        12      12          142
SALARY OFFERED LOW  2800;   MIDDLE   5300.

WELFARE PAYMENT PER UNEMPLOYED WORKER IS 1700.



 C O N T R A C T S


----------------
                            PERCENTAGE  OF    COST PER       CAPACITY        TOTAL
 TYPE   OWNER   LOCATION    TOTAL PURCHASES       UNIT       UNITS USED      COST


----------------------------------------------------------------------------------------------------------------------------------

  BG      C     98- 30           60          100000              4          400000
  BG   OUTSIDE                   40          130000              3          390000
  BS   OUTSIDE                  100          130000              3          390000

                                                                           1180000


UNDEVELOPED LAND
----------------
         LOCATION  AMOUNT     LOCATION  AMOUNT
         --------  ------     --------  ------
           92-32     18         90-28      4



                             OUTSTANDING BONDS
                             -----------------


     TYPE             ORIGINAL     REMAINING    INTEREST         ANNUAL
                      PRINCIPAL       TERM        RATE           PAYMENT
     ----             ---------    ---------    --------         -------

   CAPITAL             7000000.       11          4.5             472080.
   CAPITAL             7500000.       25          2.9             425934.
   CURRENT             8550000.        2          3.2            4481374.
```

FIGURE 40

```
*******************************************************************************************************************
                            TWOCITY
                            MUNICIPAL SERVICES DEPARTMENT FINANCES                           JURISDICTION 1      ROUND 1
*******************************************************************************************************************


                      FINANCIAL ACCOUNTING

       CAPITAL                                    CURRENT
   PREVIOUS CASH BALANCE                 0.   PREVIOUS CASH BALANCE             0.

   REVENUES                                   REVENUES
      APPROPRIATIONS                     0.      APPROPRIATIONS          10000000.
      BONDING                      7500000.      BONDING                  8550000.
      MISC. INCOME               110000000.      MISC. INCOME                   0.
                                                 FED/STATE AID                  0.

                                   -------                                -------
   TOTAL                         117500000.   TOTAL                      18550000.

   EXPENDITURES                               EXPENDITURES
      CONSTRUCTION                 6000000.      WELFARE PAYMENTS               0.
      LAND PURCHASE                   6000.      GOODS + SERVICES         1180000.
      MISCELLANEOUS                      0.      MISCELLANEOUS                  0.
                                                 SALARIES                16896000.
                                                 BOND PAYMENTS             472080,

                                   -------                                -------
   TOTAL                           6006000.   TOTAL                      18548080.

   NEW CASH BALANCE              111494000.   NEW CASH BALANCE              1920.
```

FIGURE 41

```
****************************************************************************************************
                                TWOCITY
                           MUNICIPAL SERVICES   DEPARTMENT CONSTRUCTION TABLE               JURISDICTION 1        ROUND  1
****************************************************************************************************
CONSTRUCTION       SITE                      OLD          NEW            AGREED          MAINTENANCE    EMPLOYMENT
    FIRM         LOCATION      STATUS       LEVEL        LEVEL           PRICE              LEVEL       LOW   MID.
*************    *********     ******       *****        *****        ***********       ************   *****  *****

      0             9232       COMPLETED      2            1            6000000               0           0      0
```

9. Highway Department Detail (Figure 42)

This output, which is distributed to the government decision-maker representing the Highway Department, gives the basic information necessary for the operation of the department.

a. Outstanding Bonds - the bonds which the department has outstanding. This information includes the type of bonds, the number of rounds left to pay off a bond, the original amount of the bond, and the annual payment on the bond.

b. Financial Report - summary of the capital and current expenditures and revenues for the round in addition to federal/state aid available.

c. Maintenance - the road type, its maintenance level, the total number of miles of that type in the jurisdiction, the average depreciation rate of that road type before maintenance, and the number of goods and services capacity units required to maintain that road.

d. Road Conditions - indicates value ratio of all roads with value ratios of less than 90.

e. Terminals - the location of each terminal, its level, its capacity, and the number of capacity units which are being used.

f. Undeveloped Land - indicates the amount and location of the undeveloped land which the Highway Department owns.

10. Highway Map (Figure 43)

This map shows the location and types of all highways and terminals in the city. In addition, it indicates the amount of peak-hour congestion and the value ratio of each segment of road.

11. Total Planning and Zoning Land and Institutional Land Map (Figure 44)

This map shows in the top row the zoning that is in effect on each parcel of land for whch the local jurisdiction has designated a zoning code. New land uses are not forced to change as a result of new zoning classification that are inconsistent. Parcels that have no zoning do not have any construction limitations placed upon them. The land uses allowed under each zoning classification are given in the zoning code table (section 13a page 190). The map also shows the percent of each parcel devoted to parkland and public institutional land in the middle and bottom row members respectively.

12. Parkland Usage Map (Figure 45)

This map shows the location and amount of land devoted to parks. Each parcel containing parkland has a number that indicates the percent of the parcel in parks. A "park" is all the parkland in a single parcel regardless of the percent of the parcel devoted to park use.

The middle and bottom rows indicate the local population use of the park in hundreds of people and the use index of the parcel respectively. Demand for park service is measured by the population of each parcel. The demand for a park is satisfied if the park is within a 5 by 5 grid centered by the specific residence parcel of the user. Each park within the grid is assigned a share of the residents that is proportional to its size.

Once the residence demands have been met, the park use index is computed by dividing the people served by 250 times the normalized percent of parkland for each parcel. The normalized percent parkland is the percent in parkland plus two times the percent in public institutional land.

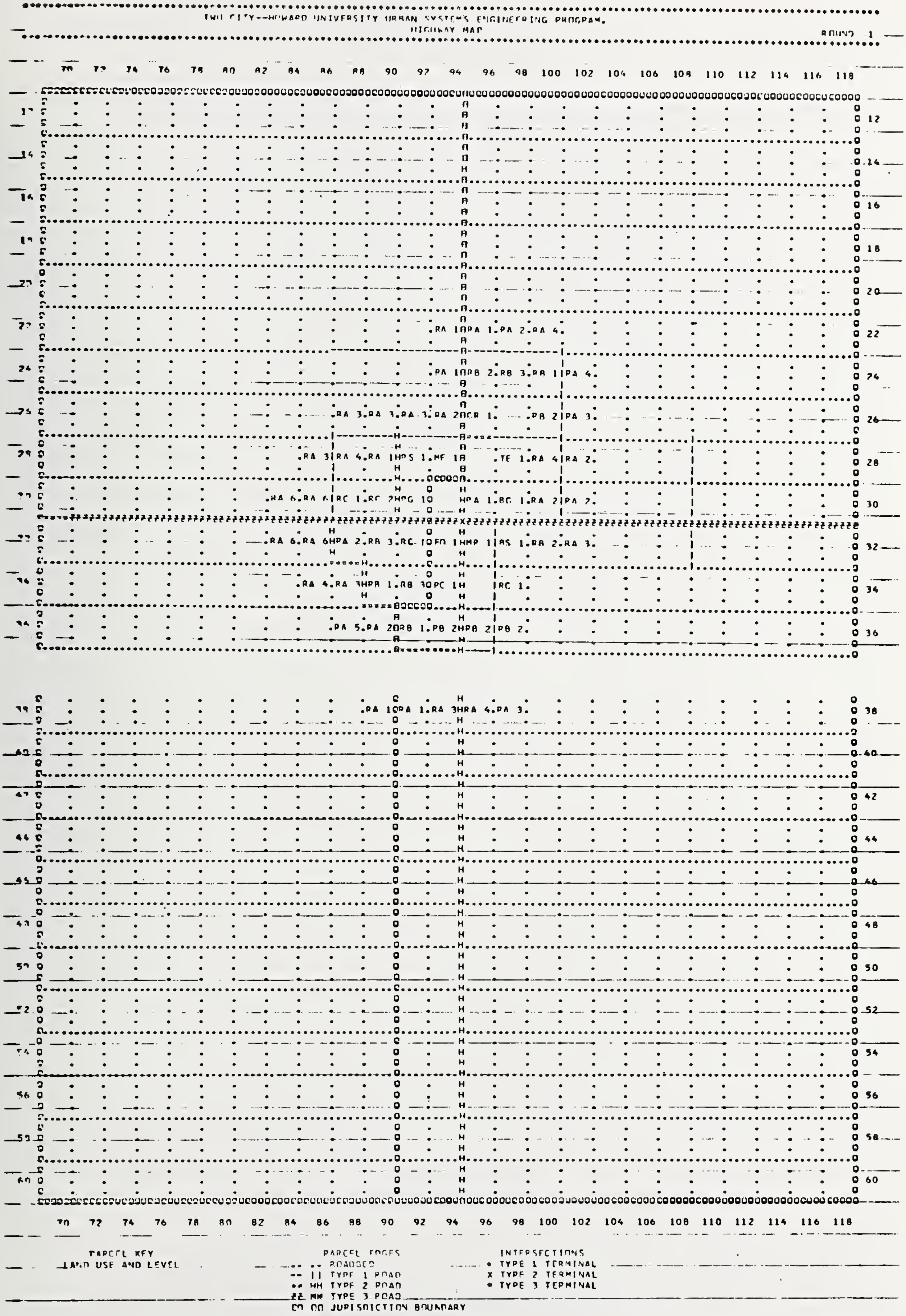
The use index affects personal dissatisfaction by diminishing the positive effect that recreational time has on it. Poor parks have use indices between 100 and 200 and a residence with no park service is served by a park with a use index of 200. When a residence is served by a park with use index equal to or less than 100 the number of units of leisure time allocated by social classes on that parcel (TR = time in recreation) are substracted from the personal dissatisfaction index. If the park index is greater than 100, the number of units substracted from the personal dissatisfaction index is equal to the park use index less 100 times TR. Thus if the park use index is worse than 200 the effect of local park service in personal dissatisfaction index is zero. As a result, park service quality has only a one sided effect on personal dissatisfaction.

```
*************************************************************************************************************
                    TWOCITY
                                   HIGHWAY - PAVEMENT FINANCES                     JURISDICTION 1       PAGE 1
*************************************************************************************************************
```

FIGURE 42

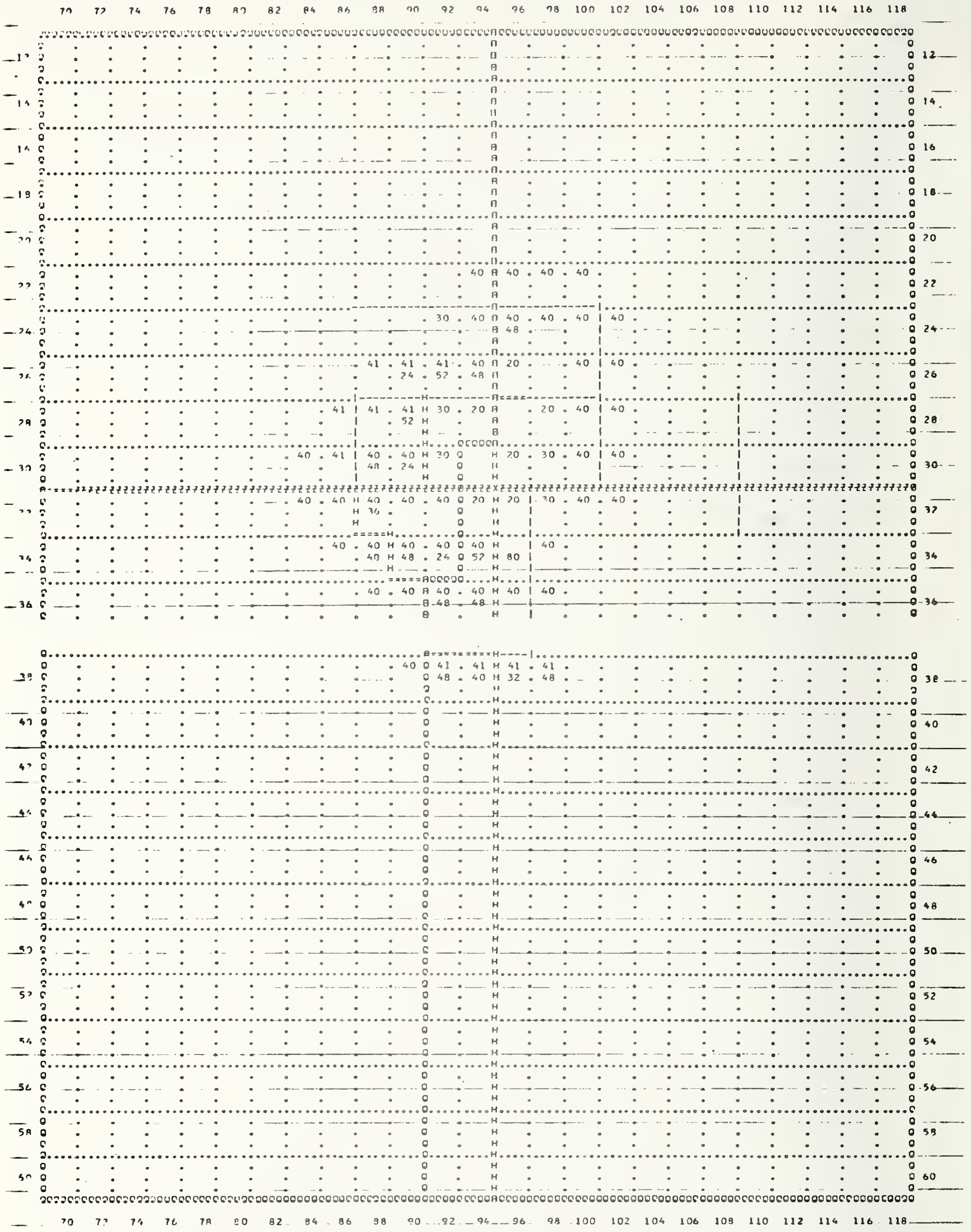
```
F I N A N C I A L   R E P O R T
-------------------------------

                       CAPITAL                                             CURRENT
                       -------                                             -------

     PREVIOUS BALANCE            $         0.              PREVIOUS BALANCE          $         0.

     REVENUES                                              REVENUES
          APPROPRIATIONS         $         0.                   APPROPRIATIONS       $    500000.
          FEDERAL/STATE AID                0.
          NEW BONDING                      0.                   NEW BONDING               220000.
          MISCELLANEOUS            250018000.                   MISCELLANEOUS            4000000.
     TOTAL REVENUE               $ 250018000.              TOTAL REVENUE             $   4720000.

     EXPENDITURES                                          EXPENDITURES
          ROAD CONSTRUCTION      $   2000000.                   ROAD MAINTENANCE     $   3955557.
          TERMINAL CONSTRUCTION            0.                   BOND PAYMENTS             354766.
          LAND PURCHASE                    0.
          MISCELLANEOUS                17000.                   MISCELLANEOUS             400000.
     TOTAL EXPENDITURES          $   2017000.              TOTAL EXPENDITURES        $   4710323.

     NEW BALANCE                 $ 248000992.              NEW BALANCE               $      9677..

                         OUTSTANDING BONDS
                         -----------------

        TYPE          ORIGINAL     REMAINING    INTEREST       ANNUAL
                      PRINCIPAL      TERM         RATE         PAYMENT
        ----          ---------    ---------    --------       -------

     CAPITAL          5000000.     13             5.0          354766.
     CURRENT           220000.      2             3.2          115310.


M A I N T E N A N C E
---------------------

          ROAD         MAINTENANCE        TOTAL        AVERAGE DEPRECIATION
          TYPE            LEVEL           MILES         BEFORE MAINTENANCE              COST

          ----         -----------        -----        --------------------        -------------

           1              90.0             22.5                2.1                $     375556.
           2              98.0             32.5                1.0                $    3066666.
           3              90.0             27.5                0.8                $     513335.


R O A D   C O N D I T I O N S   B E F O R E   M A I N T E N A N C E
-------------------------------------------------------------------

        VALUE RATIO   ROADS
                    .
        ..........................................................................................
                    .
         95 - 90 .  9514  9518  9522  9023  9223  9423  8827  8728  7031  7231  7431  7631  7831  8031  6231
                 .     0     0     0     0     0     0     6     0     0     0     0     0     0     0     0
                    .
                 .  8431  8730
                 .     0     0
                    .
                    .
        ..........................................................................................
                    .
         90 - 85 .  9526  9027  9128  9130  9731  8631  8831  8732  9031  8833  8934  9035  9136
                 .    52    29    66    34    52    10    44    35    68    26    19    13    11
                    .
                    .
        ..........................................................................................
                    .
         85 - 80 .  9727  9427
                 .   161   215
                    .
                    .
        ..........................................................................................
                    .

        THERE ARE NO ROADS IN THIS JURISDICTION WITH VALUE RATIOS BELOW 80


T E R M I N A L S
-----------------

UNDEVELOPED LAND
----------------
        LOCATION  AMOUNT    LOCATION  AMOUNT    LOCATION  AMOUNT    LOCATION  AMOUNT    LOCATION  AMOUNT
        --------  ------    --------  ------    --------  ------    --------  ------    --------  ------
          86-22      4        88-22      4        90-22      4        92-22      4        94-22      4
          86-24      4        88-24      4        90-24      4        92-24      4        94-24      4


FEDERAL/ STATE AID AVAILABLE FOR HIGHWAY CONSTRUCTION
-----------------------------------------------------

 INTERSECTION DIR. LEVEL
 -----------------------
      8725      E     1
      8925      E     1
      9125      E     1
      9325      E     1
```

FIGURE 43


TWO CITY--HOWARD UNIVERSITY URBAN SYSTEMS ENGINEERING PROGRAM.
HIGHWAY MAP
ROUND 1
70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100 102 104 106 108 110 112 114 116 118
12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60
.RA 1ORA 1.RA 2.RA 4.
.RA 1ORB 2.RB 3.RB 1|RA 4.
.RA 3.RA 3.RA 3.RA 2OCR 1.
.RB 2|RA 3.
.RA 3|RA 4.RA 1HPS 1.MF 1O
.TE 1.RA 4|RA 2.
.RA 6.RA 6|RC 1.RC 2HPG 1O
HPA 1.BC 1.RA 2|RA 2.
.RA 6.RA 6HPA 2.RB 3.RC 1OFO 1HMP 1|BS 1.RB 2.RA 3.
.RA 4.RA 3HPB 1.RB 3OPC 1H
|RC 1.
.RA 5.RA 2ORB 1.RB 2HPB 2|PB 2.
.RA 1ORA 1.RA 3HRA 4.RA 3.
PARCEL KEY
LAND USE AND LEVEL
PARCEL EDGES
.. .. ROADSED
-- || TYPE 1 ROAD
** HH TYPE 2 ROAD
ZZ NN TYPE 3 ROAD
CO OO JURISDICTION BOUNDARY
INTERSECTIONS
• TYPE 1 TERMINAL
X TYPE 2 TERMINAL
• TYPE 3 TERMINAL

```
THE CITY--HOWARD UNIVERSITY URBAN SYSTEMS ENGINEERING PROGRAM.
                              PLANNING AND ZONING MAP                                   ROUND  1
```

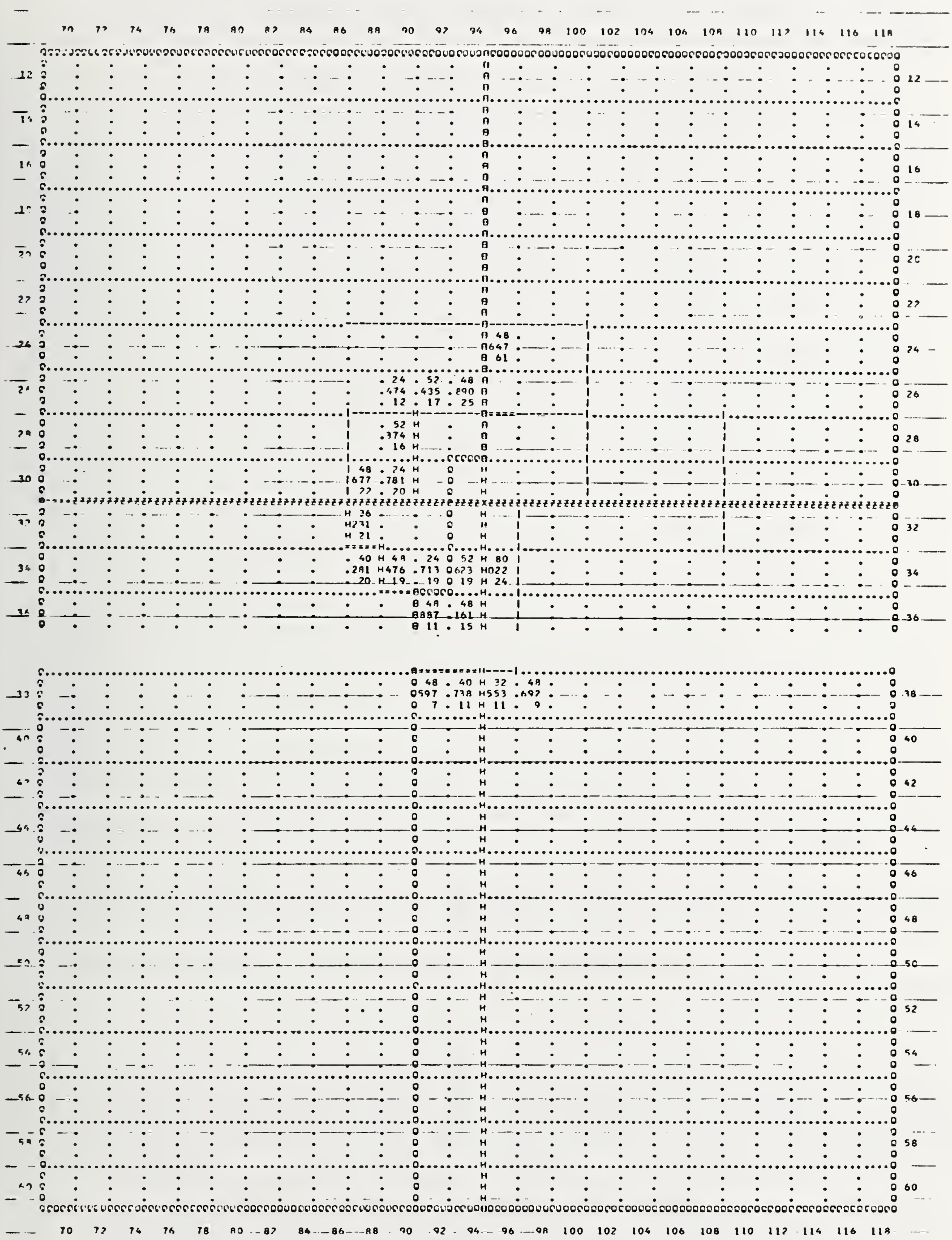
FIGURE 44



```
                 PARCELS              PARCEL EDGES                 INTERSECTIONS        ZONING  LAND USE   ZONING  USE
TOP ROW:     ZONING               .. ..  ROADBED                + TYPE 1 TERMINAL       --   ANY USE          33   BS
MIDDLE ROW:  * PARKLAND           -- ||  TYPE 1 ROAD            X TYPE 2 TERMINAL       10   ANY BUSINESS     34   PL
BOTTOM ROW:  $ PUB INST LAND      == HH  TYPE 2 ROAD            # TYPE 3 TERMINAL       20   HI,LI,CI         35   PS
                                  ## NN  TYPE 3 ROAD                                    21   HI               40   RA,RB,RC
                                  OO OO  JURISDICTION BOUNDARY                          22   LI               41   RA
                                                                                        23   CI               42   RB
                                                                                        30   NS,BG,BS,PG,PS   43   RC
                                                                                        31   NS               50   PARKLAND
                                                                                        32   BG
```

FIGURE 45

```
TWO CITY--HOWARD UNIVERSITY URBAN SYSTEMS ENGINEERING PROGRAM.
                     PARKLAND USAGE MAP                              ROUND  1
```



```
             PARCELS                              PARCEL EDGES                   INTERSECTIONS
TOP ROW:      % PARKING & PUB INST LAND         .. .. ROADBED                    + TYPE 1 TERMINAL
MIDDLE ROW: POPULATION SERVED (100'S)           -- || TYPE 1 ROAD                X TYPE 2 TERMINAL
BOTTOM ROW: PARK USE INDEX                      == HH TYPE 2 ROAD                * TYPE 3 TERMINAL
                                                ZZ WW TYPE 3 ROAD
                                                00 00 JURISDICTION BOUNDARY
```

13. Zoning Code Table

This table shows the specific zoning classification for each zoned parcel in the city. Parcels without numbers on them have not been zoned by the zoning Department.

The zoning classifications are:

	Classification
Any Use	00 or --
Any Business	10
Any Industry	20
Heavy Industry	21
Light Industry	22
Construction Industry	23
Any Commercial	30
National Service	31
Business Goods	32
Business Services	33
Personal Goods	34
Personal Services	35
Any Residential	40
Single Family	41
Townhouse	42
Highrise	43
Parkland	50

14. Planning and Zoning Detail (Figure 46)

This output indicates:

a. Population - total population of the specified jurisdiction.

b. Total Parkland - the amount of parkland owned by the Planning and Zoning Department.

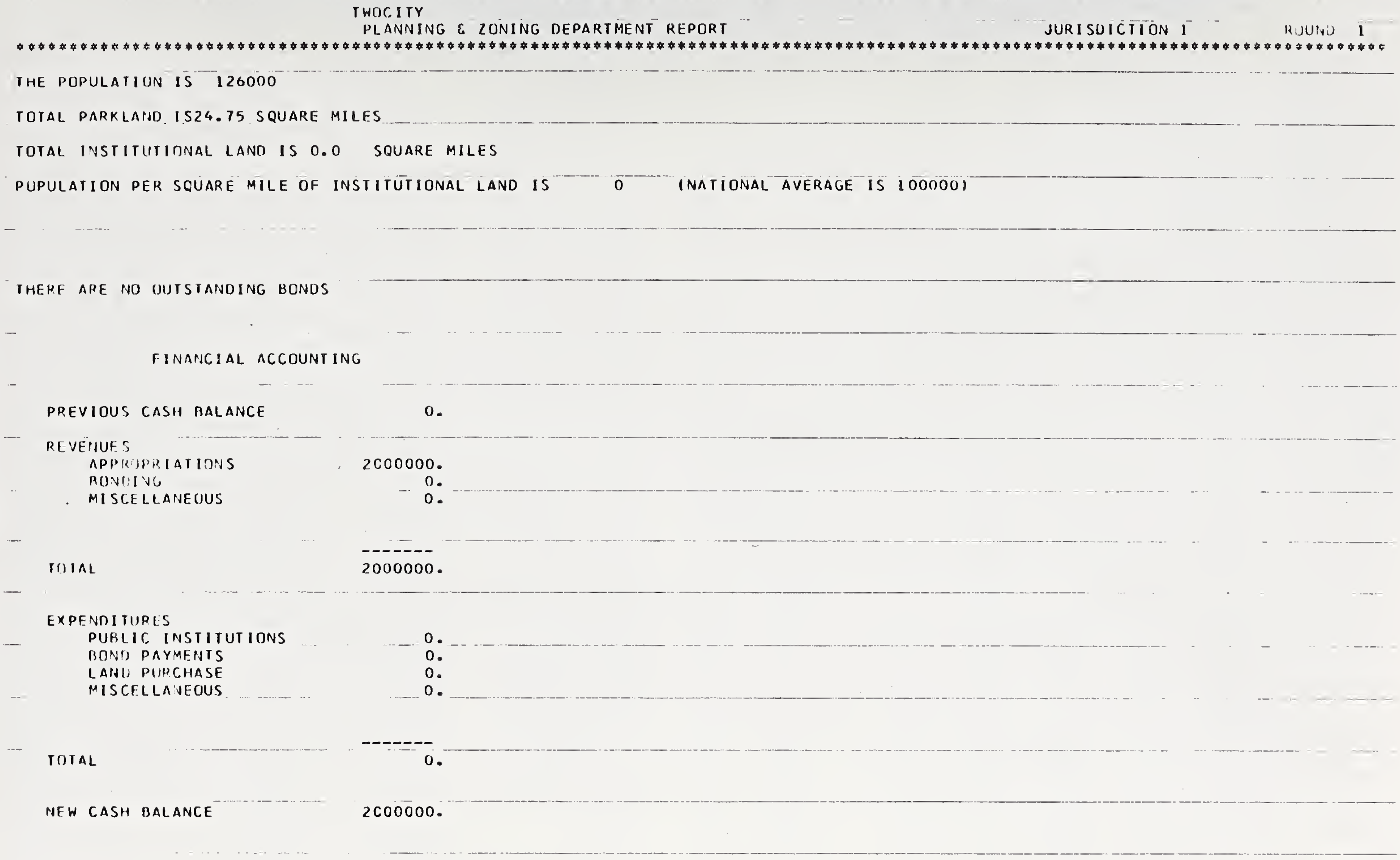
c. Outstanding Bonds - the types, remaining term, interest rate, annual payment and principal of all bonds owed by the department.

d. Financial Accounting - the total current revenues and expenditures of the department.

15. Utility Map (Figure 47)

This map gives the location of each utility plant (the parcel is surrounded by asterisks); the parcels served by each numerically designated plant (upper number); and the level of utility service supplied to each parcel (lower number).

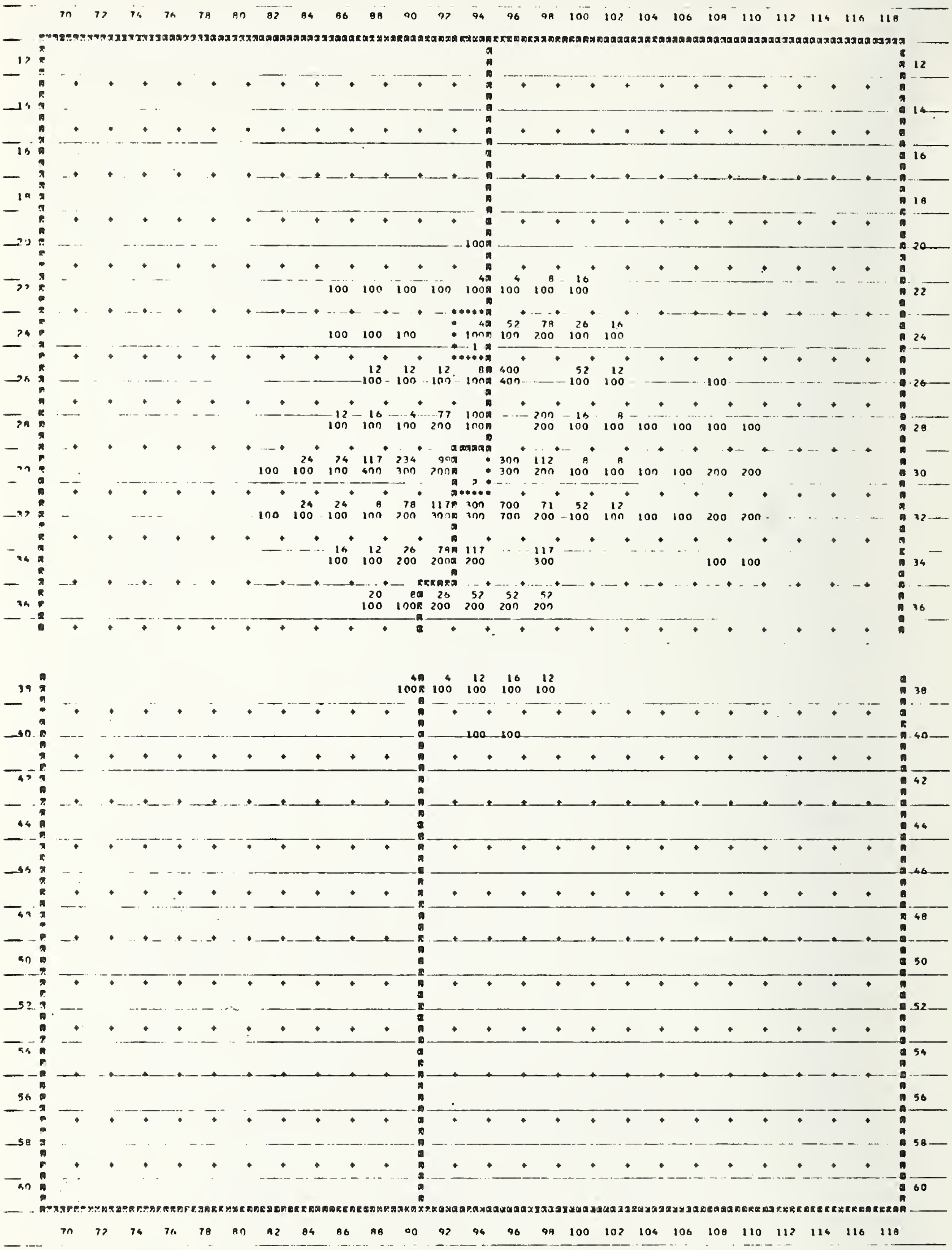
FIGURE 46



```
**************************************************************************************************************
                              TWOCITY
                                PLANNING & ZONING DEPARTMENT REPORT                                  JURISDICTION 1          ROUND  1
**************************************************************************************************************

THE POPULATION IS  126000

TOTAL PARKLAND IS24.75 SQUARE MILES

TOTAL INSTITUTIONAL LAND IS 0.0   SQUARE MILES

POPULATION PER SQUARE MILE OF INSTITUTIONAL LAND IS      0     (NATIONAL AVERAGE IS 100000)



THERE ARE NO OUTSTANDING BONDS


          FINANCIAL ACCOUNTING

  PREVIOUS CASH BALANCE               0.

  REVENUES
     APPROPRIATIONS             2000000.
     BONDING                          0.
     MISCELLANEOUS                    0.

                                -------
  TOTAL                         2000000.

  EXPENDITURES
     PUBLIC INSTITUTIONS              0.
     BOND PAYMENTS                    0.
     LAND PURCHASE                    0.
     MISCELLANEOUS                    0.

                                -------
  TOTAL                               0.

  NEW CASH BALANCE              2000000.
```

FIGURE 47

```
TWO CITY--HOWARD UNIVERSITY URBAN SYSTEMS ENGINEERING PROGRAM.
                          UTILITY MAP                                  ROUND  1
```



```
        PARCELS                                PARCEL EDGES                       UNITS REQUIRED     UNITS REQUIRED
TOP ROW:    UNITS SERVED                  XX DISTRICT BOUNDARY                    BASIC INDUSTRY     COMMERCIAL
MIDDLE ROW: UNITS INSTALLED               OO JURISDICTION BOUNDARY                  HI1  402          PG1  112
BOTTOM ROW: UTILITY CODE IF UT ON PARCEL  RR BOTH                                   LI1  135          PS1   71
                                          ** UT ON PARCEL                           NS1   76          PG1   99
                                                                                  RESIDENCES          PS1   77
                                                                                    RA1    4         CONSTRUCTION
                                                                                    RB1   26          CI1  NONE
                                                                                    RC1  117
```

16. Utility Department Detail (Figure 48)

This output shows the following things for the Utility Department of each jurisdiction.

a. Units - the numerical designation, location, development level, utility units installed, utility units served (provided), total operating costs, operating costs per utility unit, and income for each utility plant.

b. Charges to Customers - the price (determined by Utility Department) for one unit of utility service.

c. Undeveloped Land - the amount and location of undeveloped land owned by the department.

d. Outstanding Bonds - the remaining term, interest rate, annual payment and principal on all outstanding bonds owed by the department.

e. Financial Accounting - the current and capital expenditures and revenues of the department.

17. Bus Company Report (Figure 49)

This output gives the basic information necessary for the operation of the Bus Company and shows the current operating status of the bus routes.

a. Financial Report - summary of the capital and current expenditures and revenues for the round.

b. Outstanding Bonds - the number, type, remaining term and annual payment on bonds which the Bus Company has outstanding. Capital bonds have a term of 25 years and are input by the player; current bonds have a term of 2 years and are floated automatically by the computer when current expenditures exceed current revenues; all interest rates are determined by the computer and payment begins in the round after the bond is floated.

c. Employment - indicates the number of employees requested both in number of workers and number of population units (BUS hires in increments of PM's), the salary offered per worker, number of workers received (if salary is too low the Bus Company may not obtain all of the employees requested), and total salaries paid to all employees.

d. Rolling Stock - indicates the number of units presently owned, units in use, maintenance level, maintenance costs, average value ratio, and serviceable units.

Units Owned x Value Ratio = Serviceable Units

Units in Use = Units Required (if Units in Use is equal to or less than Units Owned).

FIGURE 48

```
************************************************************************************************************************
                         TWOCITY
                                 UTILITY DEPARTMENT REPORT                                 JURISDICTION 1       ROUND  1
************************************************************************************************************************
                                 UNITS        UNITS       OPERATING      OPERATING
PLANT   LOCATION      LEVEL     INSTALLED      SERVED        COSTS         COST/UNIT          INCOME

-----------------------------------------------------------------------------------------------------

  1      94-24          2         5000          1430       16511110.        11546.          13871000.

                                              TOTALS       16511110.                        13871000.
CHARGE TO CUSTOMERS --      9700 PER UNIT


UNDEVELOPED LAND
----------------
        LOCATION  AMOUNT     LOCATION   AMOUNT
        --------  ------     --------   ------
          94-24     7          82-30      4


                               OUTSTANDING BONDS
                               -----------------


      TYPE           ORIGINAL      REMAINING    INTEREST        ANNUAL
                     PRINCIPAL       TERM         RATE          PAYMENT
      ----           ---------     ---------    ---------       -------

     CAPITAL         15000000.        9            4.1           970366.
     CURRENT           150000.        2            3.1            78508.
     CURRENT          4530000.        2            3.1          2370937.
```

FIGURE 48 Continued

```
******************************************************************************************************************
                    TWOCITY
                              UTILITY DEPARTMENT FINANCES                                 JURISDICTION I     ROUND  1
******************************************************************************************************************


                    FINANCIAL ACCOUNTING

      CAPITAL                                        CURRENT
  PREVIOUS CASH BALANCE               0.        PREVIOUS CASH BALANCE              0.

  REVENUES                                      REVENUES
     SUBSIDIES                        0.           SUBSIDIES                       0.
     BONDING                          0.           BONDING                   4680000.
     MISC. INCOME             270000000.           MISC. INCOME                    0.
                                                   UTILITY USERS            13871000.
                                                   WATER USERS               2026979.

                               --------                                      -------
  TOTAL                       270000000.        TOTAL                       20577979.

  EXPENDITURES                                  EXPENDITURES
     UTILITY PLANT CONSTR.     30000000.           UTILITY OPERATION        16511110.
     TREATMENT PLANT CONSTR.    9599999.           TREATMENT OPERATION       2392742.
     MISCELLANEOUS                    0.           SAMPLING STATIONS          700000.
     EXTENSION OF SERVICE             0.           MISCELLANEOUS                   0.
     LAND PURCHASE                25000.           BOND PAYMENTS              970366.

                               --------                                      -------
  TOTAL                        39624999.        TOTAL                       20574218.

  NEW CASH BALANCE            230375001.        NEW CASH BALANCE                3761.
```

FIGURE 49

```
•••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••
                                TWOCITY
                                    BUS COMPANY FINANCES                                                   ROUND  1
•••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••

          PREVIOUS BALANCE          $          0.                PREVIOUS BALANCE          $          0.

          REVFNUES                                               REVENUFS
              SUBSIDIES             $          0.                    SUBSIDIES             $          0.
              NEW BONDING                      0.                    NFW BONDING                      0.
                                                                     FARES                            0.
              MISCELLANEOUS              3000000.                    MISCELLANEOUS                    0.
          TOTAL REVENUE             $    3000000.                TOTAL REVENUE             $          0.

          EXPENOITURES                                           EXPENOITURES
              VEHICLE PURCHASE      $          0.                    VEHICLE MAINTENANCE   $          0.
              STATION CONSTRUCTION             0.                    SALARIES                         0.
              TRACK CONSTRUCTION               0.
              LANO PURCHASE                    0.
                                                                     BONO PAYMENTS                    0.
              MISCELLANFOUS                    0.                    MISCELLANEOUS                    0.
          TOTAL EXPFNOITURES        $          0.                TOTAL EXPENOITURES        $          0.

          NEW BALANCE               $    3000000.                NEW BALANCE               $          0.

 THERE ARE NO OUTSTANOING BONOS


  E M P L O Y M E N T
 --------------------

          EMPLOYFFS       SALARY        EMPLOYEES        SALARIES
          REQUESTED       OFFEREO       RECEIVEO           PAIO
          ---------      ---------     ------------

              0               0              0        $         0
           0 UNITS                        0 UNITS

 R O L L I N G   S T O C K
 -------------------------

          UNITS     UNITS     MAINTENANCE     MAINTENANCE COST        AVERAGE        SERVICEABLE
          OWNEO     IN USE       LEVEL        GOODS / SERVICES      VALUE RATIO         UNITS
          ------    ------    -----------   -------------------    -----------     -----------

            0        0.0         0%               0.         0.        0.0              0

 T R A N S I T   S U M M A R Y
 -----------------------------

          FARES
          -----

              FARES HAVE BEEN SET AT  0 CENTS, PLUS  0 CENTS PER MILE.
```

FIGURE 49 (Cont'd)

```
T R A N S I T   S U M M A R Y
-----------------------------

        FARES
        -----

             FARES HAVE BEEN SET AT 15 CENTS, PLUS  2 CENTS PER MILE.

        PASSENGERS
        ----------

             ROUTE     LEVEL OF     LENGTH    PERSONNEL     UNITS       TOTAL       AVERAGE TRIP
             NUMBER    SERVICE      (MILES)   REQUIRED     REQUIRED   PASSENGERS      (MILES)

             ------    --------     -------   ----------   --------   ----------   ------------


              101         1            5          40          200        1920           2.8
              102         1            7          56          280        4080           4.8
              103         1            3          24          120           0            .8
              104         1            3          24          120        2720           1.1


             TOTAL                    18         144          720        8720


R O U T E S
-----------

        ROUTE NUMBER      STOPS



        ------------      -----
            101              8531 -->-->-->--  8731 -->-->-->--  8931 -->-->-->--  9131 -->-->-->--  9331 -->-->-->
                             0    720   720   360  720  1080     0   160  1240   160     0  1080   120   320  1280

                         --  9531
                          1280    0     0
            102              8731 -->-->-->--  8724 -->-->-->--  8727 -->-->-->--  8927 -->-->-->--  9127 -->-->-->
                             0    840   840     0  1600  2440     0   360  2800     0   960  3760   360   320  3720

                         --  9327 -->-->-->--  9527 -->-->-->--  9727
                          160     0  3560  1160     0  2400  2400     0     0
            103             10131 -->-->-->--  9931 -->-->-->--  9731 -->-->-->--  9531
                             0      0     0     0     0     0     0     0     0     0     0     0
            104              9537 -->-->-->--  9535 -->-->-->--  9533 -->-->-->--  9531
                             0    360   360     0   800  1160  1160  1560  1560  1560     0     0


        LEGEND:    -- SSSSS.-->-->-->       SSSSS   IS INTERSECTION OF STOP.                  .    IS LAST STOP IN ZONE
                   FFFFF NNNNN PPPPP        FFFFF   IS NUMBER OF PEOPLE GETTING OFF,      NNNNN   IS NUMBER OF PEOPLE GETTING ON
                                            PPPPP   IS NUMBER OF PASSENGERS ON VEHICLE BETWEEN STOPS
```

e. Transit Summary - indicates fares set by the Bus Company on either a base cost or a base cost plus mileage basis. Also presents information on each route as to level of service, length, personnel and equipment required, total passengers (including transfer passengers), and average length of trip.

f. Routes - indicates, by route, where BUS stops, how many passengers got off at that stop, how many got on, and how many are riding to the next stop.

18. Rail Company Report (Figure 50)

The first six sections of the RAIL output are nearly identical to BUS output. There is, in addition, a section of output following "Routes" entitled "Undeveloped Land" which indicates the undeveloped land which is owned by the Rail Company and which can be used for surface track construction (RAIL can build track either on the surface or underground). All land purchased by RAIL and not used will be lsited here by parcel location and percent of parcel owned.

19. Transportation Network Maps (Figure 51)

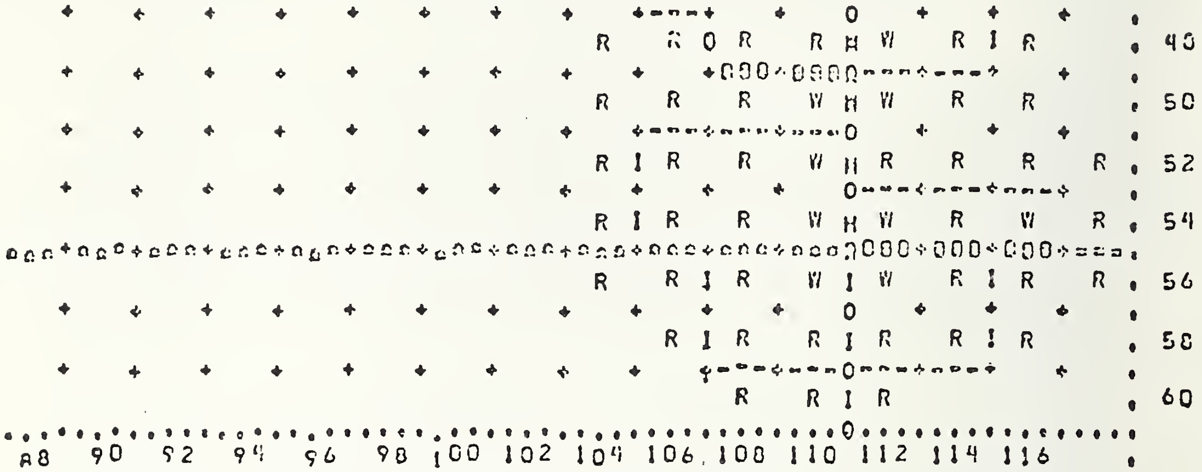
These maps summarize the three modes of transportation (bus, rail and highway) in the city. They should be used by the transportation decision-makers to plan their routes.

FIGURE 50

```
*******************************************************************************************************************
                              TWOCITY
                               RAILROAD COMPANY FINANCES                                                  ROUND  1
*******************************************************************************************************************

     PREVIOUS BALANCE            $        0.            PREVIOUS BALANCE            $        0.

     REVENUES                                           REVENUES
         SUBSIDIES               $        0.                SUBSIDIES               $        0.
         NEW BONDING                      0.                NEW BONDING                      0.
                                                            FARES                            0.
         MISCELLANEOUS                    0.                MISCELLANEOUS            400000000.
     TOTAL REVENUE               $        0.            TOTAL REVENUE               $ 400000000.

     EXPENDITURES                                       EXPENDITURES
         VEHICLE PURCHASE        $        0.                VEHICLE MAINTENANCE     $        0.
         STATION CONSTRUCTION             0.                SALARIES                         0.
         TRACK CONSTRUCTION               0.
         LAND PURCHASE                    0.
                                                            BOND PAYMENTS                    0.
         MISCELLANEOUS                    0.                MISCELLANEOUS                    0.
     TOTAL EXPENDITURES          $        0.            TOTAL EXPENDITURES          $        0.

     NEW BALANCE                 $        0.            NEW BALANCE                 $ 400000000.


THERE ARE NO OUTSTANDING BONDS


E M P L O Y M E N T
-------------------

     EMPLOYEES       SALARY         EMPLOYEES        SALARIES
     REQUESTED       OFFERED        RECEIVED           PAID
     ---------       -------        ---------

         0              0              0        $        0
      0 UNITS                       0 UNITS


R O L L I N G   S T O C K
-------------------------

     UNITS     UNITS     MAINTENANCE     MAINTENANCE COST      AVERAGE       SERVICEABLE
     OWNED     IN USE       LEVEL        GOODS / SERVICES     VALUE RATIO       UNITS
     -----     ------    -----------    ------------------    -----------    ----------

       0        0.0          0%            0.        0.          0.0             0


T R A N S I T   S U M M A R Y
-----------------------------

     FARES
     -----

          FARES HAVE BEEN SET AT  0 CENTS, PLUS  0 CENTS PER MILE.

     NO UNDEVELOPED LAND
```

FIGURE 51

TRANSPORTATION NETWORK MAP ROUND 1



O TRACK PASSES THROUGH INTERSECTION X STATION AT INTERSECTION
-I TYPE 1 ROAD =H TYPE 2 ROAD ≡H TYPE 3 ROAD O BUS ROUTES
W WORK LOCATION R RESIDENTIAL LOCATION

LIST OF TRACK SEGMENTS

11119 TO 11317 11317 TO 11515 11515 TO 11713
11123 TO 11125 11125 TO 11127 11127 TO 11129
11135 TO 11137 11137 TO 11139 11139 TO 11141
11147 TO 11149 11149 TO 11151 11151 TO 11153
11159 TO 11161

LIST OF STATIONS

11515 11119 11123 11127 11143 11149 11155

VII. INPUT PROCEDURES

Since City Model is a computer-assisted model, it is necessary that information be fed to the computer in a certain format. This format is quite elementary and requires no knowledge of computer programming. It merely involves filling out forms properly with the required information for each decision.

A. Using Forms

In order to make a decision and feed it to the computer, participants in the City Model game must complete an input decision form (See Figure 52) with certain information. The information which is required on the input decision form varies with the type of decision being implemented. The type of information which is required is explained on the input explanation forms (see pages

An input decision form has the following components: Decision Code, Decision-Maker, and additional information. Each of these components is explained below:

1. Decision Code

This indicates the type of decision that is being made. It is usually an abbreviation preceded by a dollar sign ($). Essentially, the decision code describes the type of decision being made to the computer. They correspond to the codes listed in parentheses next to the explanation of decisions in the preceding chapters of this manual. These codes are summarized below for all decision-makers.

a. $CVPT - Change SC or MS employment; change zoning; establish utility service level; change maintenance levels; change economic sector rents, prices, salaries; award BG and BS contracts.

b. $PU - Bid and/or purchase land and developments from another team or from the outside.

c. $OTHER - Set government salaries; float capital bonds; change maintenance levels; lend or borrow money; buy or sell speculative or conservative stocks; set welfare payments; purchase or sell rail and bus rolling stock; set utility prices.

d. $BUILD - Construct, upgrade or demolish a development by the local Construction Industry.

e. $OUBLD - Construct, upgrade, or demolish a development by the Outside System.

f. $CASH - Transfer cash between accounts of two decision-makers; grant appropriations or subsidies.

FIGURE 52

INPUT DECISION FORM

Note: When filling out this form, refer to input description form in the manual.

Please write clearly; distinguish between 1 (one) and "I" (eye), "Ø" (oh) and 0 (zero); be sure to fill in numbers exactly as required, omitting commas within numbers (100000).

Decision Code	Decision-Maker	a	b	c	d	e	f	g	h	i	j	k	l
$ ______ /	= ______ /	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______
$ ______ /	= ______ /	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______
$ ______ /	= ______ /	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______
$ ______ /	= ______ /	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______
$ ______ /	= ______ /	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______
$ ______ /	= ______ /	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______
$ ______ /	= ______ /	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______
$ ______ /	= ______ /	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______
$ ______ /	= ______ /	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______
$ ______ /	= ______ /	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______
$ ______ /	= ______ /	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______
$ ______ /	= ______ /	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______
$ ______ /	= ______ /	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______
$ ______ /	= ______ /	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______

g. $BYCT - Boycott work or shop locations or use of BUS or RAIL.

h. $TAXES - Set tax rates.

i. $FSA - Request capital federal/state aid.

j. $REDIST - Change school or municipal services districts.

k. $VALUE - Set the dollar value of time unit traveling.

l. $TIME - Allocate time for population units.

m. $ROUT - Change Bus or Rail routes.

n. $RAIL - Build rail lines and stations.

o. $ASMNT - Set assessment criteria.

2. Decision-Maker

This term identifies the decision-maker who is implementing a decision. The decision-maker codes for the economic sector are A, B, C, etc. The decision-maker identification codes for the governmental sector are: CH (Chairman); AS (Assessment); SC (Schools); MS (Municipal Services); HY (Highway); PZ (Planning and Zoning); UT (Utilities); RAIL (Rapid Rail); and BUS (Bus). Governmental decision-makers (except BUS and RAIL) must identify their jurisdiction when filling in the form. For example, "CH1" indicates the Chairman in Jurisdiction 1.

3. Additional Information

Additional information concerning a decision is filled in the spaces immediately following the decision-maker identification. These spaces correspond to the columns marked (a), (b), (c), etc., on the input decision form. The amount and type of additional information varies with the type of decision being made.

To clarify this procedure, the reader should review the sample decisions made in Figure 53 following

FIGURE 53

SAMPLE DECISIONS

1. The School Department in jurisdiction 1 changes salaries to $6,500 for PM teachers and $11,500 for PH teachers.

Decision Code	Decision-Maker	a	b	c	d	e	f	g	h	i	j	k	l
$ OTHER /	= SC1 /	S,	65,	115,	,	,	,	,	,	,	,	,	

2. Economic decision-maker A lends one million dollars to E. The term of the loan is 25 years and the interest rate is 6 percent.

Decision Code	Decision-Maker	a	b	c	d	e	f	g	h	i	j	k	l
$ OTHER /	= A /	LO,	100,	25,	60,	E,	,	,	,	,	,	,	

3. Economic decision-maker G invests $100,000 in speculative stocks.

Decision Code	Decision-Maker	a	b	c	d	e	f	g	h	i	j	k	l
$ OTHER /	= G /	SP,	100000,	,	,	,	,	,	,	,	,	,	

4. Social decision-maker CC allocates time for high-income population units which he controls in jurisdiction 1. He allocates 25 time units each for extra work and adult education; and 20 time units each for politics and recreation.

Decision Code	Decision-Maker	a	b	c	d	e	f	g	h	i	j	k	l
$ TIME /	- CC /	111,	25,	0,	25,	20,	20,	,	,	,	,	,	

FIGURE D

ECONOMIC DECISION-MAKERS: INPUT EXPLANATION FORM

Type of Decision	Code	Decision-Maker	a	b	c	d	e
Purchase or bid on land	$PU	A, B, C, etc.	location	price (in $1000's)	seller (economic decision-maker or department and jurisdiction or, if bid, OU)	if from department, percent of parcel	
Change Rents	$CVPT	A, B, C, etc.	R	location	new rent/PL1 (in $1000's)		
Change Prices	$CVPT	A, B, C, etc.	P	location	basic price/CU (in $100's)		
Change Salaries	$CVPT	A, B, C, etc.	S	location	salary to low income (specified as salary per worker in $100's)	salary to middle income (specified as salary per worker in $100's)	salary to high income (specified as salary per worker in $100's)
Change Maintenance Level	$CVPT	A, B, C, etc.	M	location	new maintenance level		
Lend Money	$OTHER	A, B, C, etc.	LO	amount (in $10,000's)	term (2 or 25)	interest rate (in mils)	borrower
Borrow Money from the Outside System	$OTHER	A, B, C, etc.	BO	amount (in $10,000's)	term (2 or 25)		

Type of Decision	Code	Decision-Maker	a	b	c	d	e
Invest in speculative stocks	$OTHER	A, B, C, etc.	SP	amount (in dollars)			
Invest in conservative stocks	$OTHER	A, B, C, etc.	CN	amount (in dollars)			
Sell speculative stocks	$OTHER	A, B, C, etc.	SELLSP	amount (in dollars)			
Sell conservative stocks	$OTHER	A, B, C, etc.	SELLCN	amount (in dollars)			
Build, upgrade or demolish by Outside System	$OUBLD	A, B, C, etc.	site location	land use	old level (0 if new building)	new level	maintenance level
			f	g	h		i
			if residence, quality index; if business, salary to low-income worker (in $100's)	if residence, 0; if business, salary to middle income worker (in $100's)	if residence, rent per PL1 (in $1000's); if business, salary to high-income worker (in $100's)		if commercial (BG, BS, PG, PS), price/CU (in $100's)

Type of Decision	Code	Decision-Maker	a	b	c	d	e	f	g	h	i	j	k	l
Build, upgrade, or demolish by local Construction Industry	$BUILD	CI owner	CI Location	Contractee (economic decision-maker or department and jurisdiction)	Site location	land use (RA, RB, RC HI, LI, NS, BG, BS, PG, PS, SC, HY, TM, MS)	old level (0, if new building)	new level	agreed price (in $100,000's)	maintenance level unless HY or TM; if HY or TM is on jurisdiction boundaries, list of jurisdictions separated by commas	if residence, quality index; if business, salary to low income worker (in $100's); if SC or MS, number of middle or low income Pl's employed there	if residence, 0, if business, salary to middle income worker (in $100's); if SC or MS, number of high or middle income Pl's working there	if residence rent per PLI (in $1000's); if business salary to high income worker (in $100's)	if commercial (BG, BS, PG, PS) price/CU in $100's)

Type of Decision	Code	Decision-Maker	a	b	c	d	e	f
Transfer cash	$CASH	A,B,C, etc.	C	Receiver (economic decision-maker or department and jurisdiction)	amount (in dollars)	PVT	if economic decision-maker receiving, PVT; if department receiving CAPital or CURrent account	
Boycott Commercial establishments	$BYCT	A, B, C, etc.	E	land use boycotting	S	location boycotted	Stop the Boycott or Begin it	

SOCIAL DECISION-MAKERS: INPUT EXPLANATION FORM

Type of Decision	Code	Decision Maker	a	b	c	d	e	f	g
Allocate time by jurisdiction, by class	$TIME	AA, BB, CC, etc.	Class (H, M, or L) and jurisdiction (1,2,or3)	time units in extra work; if none, 0	time units in public adult education, if none,0	time units in adult education; if none, 0	time units in politics; if none, 0	time units in recreation; if none, 0	
Allocate time by jurisdiction, by class, by parcel	$TIME	AA, BB, CC, etc.	Class (H, M, or L) and jurisdiction (1,2,or 3)	time units in extra work; if none, 0	time units in public adult education; if none, 0	time units in adult education; if none, 0	time units in politics; if none, 0	time units in recreation; if none, 0	residence location
Boycott	$BYCT	AA, BB, CC, etc.	S	Class boycotting (H, M, or L)	function boycotted (Shop or Work or Use)	location boycotted (0 if department)	Stop the boycott or Begin it	if applicable, department (SC, MS) and jurisdiction (1,2, or 3)	
Vote	$VOTE	(Teletype will print further instructions.)							
Change dollar value of time for PI's	$VALUE	AA, BB, CC, etc.	Class (H, M, or L)	dollar value of time unit traveling					

CHAIRMAN & COUNCIL: INPUT EXPLANATION FORM

Type of Decision	Code	Decision Maker	a	b	c	d	e
Grant Capital Appropriations	$CASH	CH1, CH2 or CH3	CP	department receiving and jurisdiction	amount (in dollars)		
Grant Current Appropriations	$CASH	CH1, CH2 or CH3	CR	department receiving and jurisdiction	amount (in dollars)		
Grant Current Subsidy	$CASH	CH1, CH2 or CH3	CURS	department receiving and jurisdiction	amount (in dollars)		
Grant Capital Subsidy	$CASH	CH1, CH2 or CH3	CAPS	department receiving and jurisdiction	amount (in dollars)		
Transfer Cash	$CASH	CH1, CH2 or CH3	C	receiver (economic decision-maker or department and jurisdiction)	amount (in dollars)	CUR	if economic decision-maker receiving, PVT, if department receiving, to CAPital or CURrent account
Grant Subsidy to Economic Decision-Maker	$CASH	CH1, CH2 or CH3	SB	receiver	amount (in dollars)		

CHAIRMAN & COUNCIL: INPUT EXPLANATION FORM (Continued)

Type of Decision	Code	Decision Maker	a	b	c	d	e
Set Welfare Payments	$OTHER	CH1, CH2 or CH3	W	amount per unemployed worker (in $100's)			
Change land tax rate	$TAXES	CH1, CH2 or CH3	L	land tax rate (in mils)			
Change development tax rate	$TAXES	CH1, CH2 or CH3	D	development rate (in mils)			
Change resident (or employee) income tax rate	$TAXES	CH1, CH2 or CH3	RI (or ET)	resident (or employee) income (in mils)			
Change resident (or employee) auto tax rate	$TAXES	CH1, CH2 or CH3	RA (or EA)	resident (or employee) auto expenses (in mils)			
Change goods sales tax rate	$TAXES	CH1, CH2 or CH3	G	goods tax rate (in mils)			
Change services sales tax rate	$TAXES	CH1, CH2 or CH3	S	services tax rate (in mils)			
Float Capital Bonds	$OTHER	department receiving and jurisdiction	BO	amount (in $10,000's)	25		

ASSESSMENT DEPARTMENT: INPUT EXPLANATION FORM (see notes at end of this section)

Type of Decision	Decision Code	Decision Maker	a	b	c
1. Change Development Assessment Rates for all land uses jurisdiction-wide	$ASMNT	AS1, AS2 or AS3	D	Development Assessment Rate in tenths of a percent (i.e., "500" equals "50%")	
2. Change Land Assessment Rate Jurisdiction-wide	$ASMNT	AS1, AS2 or AS3	L	Land Assessment Rate in tenths of a percent (i.e., "500" equals "50%")	
3. Change Development Assessment Rate for a particular land use	$ASMNT	AS1, AS2 or AS3	D and land use code (i.e., DH1 DLI, DNS, DCF, DBG, DBS, DPG, DPS, DRA, DRB, or DRC)	Development Assessment Rate in tenths of a percent (i.e., "500" equals "50%")	

Type of Decision	Decision Code	Decision Maker	a	b	c	d	e
4. Change Land Assessment Rate for parcels with a particular land use	$ASMNT	AS1, AS2 or AS3	L and land use code (i.e. LHI, LLI, LNS, LCI, LBG, LBS, LPG, LPS, LRA, LRB, LRC, or LUL)[1]	Land Assessment Rate in tenths of a percent (i.e., "500" equals "50%")			
5. Define Special Zones[2]	$ASMNT	AS1, AS2 or AS3	SZ	zone number (1,2,3,4, etc.)	list of upper left and lower right intersections coordinates[3]		if any other special zone is to have same special rates as this, zone number here
6. Change Development of Land Assessment Rates within a Special Zone	$ASMNT	AS1, AS2 or AS3	Development or Land	Land or Development Assessment Rate in tenths of a percent (i.e., "500" equals "50")	Zone number		

---

1. "UL" is the land use code for undeveloped land.
2. No special zones are carried from one round to the next, they must be re-defined each round before any special rates by zone are initiated.
3. Intersection coordinates are odd-numbered. Thus "9125, 9933" would include all parcels in the rectangle formed by parcel 9226 in the upper left hand corner and parcel 9832 in the lower right hand corner.

Type of Decision	Decision Code	Decision Maker	a	b	c	d
7. Change Development Assessment Rate for a particular land use or change Land Assessment rate for parcels with a particular land use within a special zone.	$ASMNT	AS1, AS2 or AS3	Development or Land and land use code (i.e., DHI, DLI, or LHI, LLI etc.)	Land or Development Assessment Rate in tenths of a percent (i.e., "500" equals "50%")	Zone number	
8. Make Special Assessments for land and developments by parcel location	$ASMNT	AS1, AS2	SA	Location	Assessed value of land (in $100,000's)	Assessed Value of Developments (in $100,000's)

NOTE: (1) After all assessment decisions are made, write "ASMNT/#AS1, 2, or 3/END" on the last line of the input decision form.

(2) The order in which assessment inputs are placed.

SCHOOL DEPARTMENT: INPUT EXPLANATION FORM

Type of Decision	Code	Decision Maker	a	b	c	d	e	f
Purchase or bid on land	$PU	SC1, SC2, or SC3	location	price (in $1000's)	seller (economic decision-maker or department)	percent of parcel (0 if all)		
Change employment	$CVPT	SC1, SC2 or SC3	E	location	new number of PM units working there	new number of PM units working there		
Change maintenance level	$CVPT	SC1, SC2, or SC3	M	location	new maintenance level			
Change district boundaries	$REDIST	SC1, SC2 or SC3	location of school	list of new parcels in district in parentheses*				

*Parcels can be listed within parentheses by specifying upper left and lower right hand corners separated by ">" Example:

$REDIST/=SC1/(9232 > 10040)

Type of Decision	Code	Decision-Maker	a	b	c	d	e	f	g
Request Federal-state aid	$FSA	SC1, SC2, or SC3	new level of school for which aid is requested (1, 2, or 3)	location					
Change salaries	$OTHER	SC1, SC2, or SC3	S	salary to middle income worker (in $100's)	salary to high income worker (in $100's)				
Construct, upgrade or demolish a school by the "Out-side System"	$OUBLD	SC1, SC2, or SC3	a	b	c	d	e	f	g
			site location	SC	old level (0, if new building)	new level	new maintenance level	number of PM's working	number of PH's working there
Construct, upgrade or demolish a school by the local Construction Industry			[See CI owner]						

Type of Decision	Code	Decision-Maker	a	b	c	d	e	f
Transfer cash	$CASH	SC1, SC2, or SC3	C	receiver (economic decision-maker or department and jurisdiction)	amount (in dollars)	from CAPital or CURrent account	if economic decision-maker receiving, PVT: if department receiving, to CAPital or CURrent account	
Award BG or BS contracts	$CVPT	SC1, SC2, or SC3	C	location of BG or BS establishment	percent of total BG or BS purchase to be bought there	new priority	displaced priority	owner of BG or BS establishment
Request adult education teachers	$OTHER	SC1, SC2, or SC3	EA	number of middle-income time units requested	number of high-income time units requested			

MUNICIPAL SERVICES DEPARTMENT: INPUT EXPLANATION FORM

Type of Decision	Code	Decision Maker	a	b	c	d	e
Purchase or bid on land	$PU	MS1, MS2, or MS3	location	price (in $1000's)	seller (economic decision-maker or department and juris diction or OU)	percent of parcel (0 if all)	
Change employment	$CVPT	MS1, MS2, or MS3	E	location of plant	new number of PL's working there	new number of PM's working there	
Change maintenance level	$CVPT	MS1, MS2, or MS3	M	location of plant	new maintenance level		
Change district boundaries	$REDIST	MS1, MS2, or MS3	location of MS plant	list of new parcels in parentheses*			

*Parcels can be listed within parentheses by specifying upper left and lower right hand corners separated by ">". Example:

$REDIST/=MS/9230, (9232>10040)

Type of Decision	Code	Decision Maker	a	b	c	d	e	f	g
Award BG or BS contracts	$CVPT	MS1, MS2, or MS3	C	location of BG or BS establishment	percent of total BG or BS purchase to be brought there	new priority	displaced priority	owner	
Change salaries	$OTHER	MS1, MS2, or MS3	S	new salary to low-income worker (in $100's)	new salary to middle-income worker (in $100's)				
			a	b	c	d	e	f	g
Construct, upgrade, or demolish an MS plant in the "Outside System"	$OUBLD	MS1, MS2, or MS3	site	MS	old level (0 if new building)	new level	maintenance level	new number of PL's working there	new number of PM's working there
			a	b	c	d	e	f	
Construct, upgrade or demolish MS plant by a local Construction Industry		[see CI owner]							

Type of Decision	Code	Decision Maker	a	b	c	d	e	f
Transfer cash	$CASH	MS1, MS2, or MS3	C	receiver (economic decision-maker of department and jurisdiction)	amount (in dollars)	from CAPital or CURrent account	if economic decision-maker receiving, PVT; if department receiving; to CAPital or CURrent account	

HIGHWAY DEPARTMENT: INPUT EXPLANATION FORM

Type of Decision	Code	Decision Maker	a	b	c	d	e
Purchase or bid on land	$PU	HY1, HY2 or HY3	location	price (in $1000's)	seller economic decision-maker or department and jurisdiction or OU)	percent of parcel (o if all)	
Change Maintenance Level	$OTHER	HY1, HY2 or HY3	M	new maintenance level	type of road (1, 2, or 3)		
Construct, upgrade or demolish a road or terminal by the "Outside System"	$OUBLD	HY1, HY2 or HY3	site location	HY if road TM if terminal	old level (0 if new road or terminal)	new level	if on jurisdiction boundary, jurisdiction numbers, separated by commas
Construct, upgrade or demolish a road or terminal by the local construction industry				[See CI owner]			
Request federal-state aid	$FSA	HY1, HY2 or HY3	new level for which aid requested (1, 2, or 3)	list of coordinates of end intersections of straight road sections in parentheses [e.g., $FSA/=HY1/2, (9927, 9931, 9931, 8731)			

HIGHWAY DEPARTMENT: INPUT EXPLANATION FORM

Type of Decision	Code	Decision Maker	a	b	c	d	e
Transfer Cash	$CASH	HY1, HY2 or HY3	C	receiver (economic decision-maker or department and jurisdiction)	amount (in dollars)	from CAPital or CURrent account	if economic decision-maker is receiving, PVT; if department is receiving to CAPital or CURrent account

PLANNING AND ZONING DEPARTMENT: INPUT EXPLANATION FORM

Type of Decision	Code	Decision-Maker	a	b	c	d	e
Purchase or bid on land	$PU	PZ1, PZ2, or PZ3	location	price (in $1000's	seller (economic decision-maker or department and jurisdiction or OU)	percent of parcel (0 if all)	
Change zoning	$CVPT	PZ1, PZ2, or PZ3	Z	location	new zoning code		
Request Federal-state aid	$FSA	PZ1, PZ2, or PZ3	amount (in $1000's)	[maximum 3 requests]			
Transfer cash	$CASH	PZ1, PZ2, or PZ3	C	receiver (economic decision-maker or department and jurisdiction)	amount (in dollars)	CAP	if economic decision-maker is receiving, PV if department is receiving to CAPital or CURrent account
Create Public institutional land use	$CVPT	PZ1, PZ2, or PZ3	PI	location	percent to be added to public institutional		
Demolish public institutional land use	$CVPT	PZ1, PZ2, or PZ3	RPI	location	percent to be subtracted from public institutional		

UTILITY DEPARTMENT: INPUT EXPLANATION FORM

Type of Decision	Code	Decision-Maker	a	b	c	d	e
Purchase or bid on land	$PU	UT1, UT2, or UT3	location	price (in $1000's)	seller (economic decision-maker or department or OU)	percent of parcel (0 if all)	
Change utility service	$CVPT	UT1, UT2, or UT3	US	location	location of plant serving	new level of service	
Change prices	$OTHER	UT1, UT2, or UT3	P	new price per unit of utility service			
Construct, upgrade or demolish a utility p plant	$OUBLD	UT1, UT2, or UT3	site location	UT	old level (0 if new plant)	new level	
Transfer cash	$CASH	UT1, UT2, or UT3	C	receiver (economic decision-maker or department and jurisdiction)	amount (in dollars)	from CAPital or CURrent account	if economic decision-maker receiving, PVT; if department receiving, to CAPital or CURrent account

BUS COMPANY: INPUT EXPLANATION FORM

Type of Decision	Code	Decision-Maker	a	b	c	d	e
Change routes or level of service	$ROUT	BUS	Route	Old level of service	New level of service (0 if eliminating route)	list, in parentheses, of intersections in in order, where bus starts, turns, and finishes (0 if no changes to route location)	0
Transfer Cash	$CASH	BUS	C	receiver (economic decision-maker or department and jurisdiction)	amount (in dollars)	from CAPital or CURrent account	if economic decision-maker receiving, PVT if department receiving, to CAPital or CURrent account
Purchase Rolling Stock	$OTHER	BUS	PS	number of units of equipment			
Sell Rolling Stock	$OTHER	BUS	SS	number of units of equipment			

Type of Decision	Code	Decision-Maker	a	b	c	d	e
Set Fares	$OTHER	BUS	P	base fare per worker, per journey (in ¢)	0	price per mile (in¢)	
Change salaries	$OTHER	BUS	S	new salary to PM worker (specified as salary per worker in $100's)			
Change maintenance level	$OTHER	BUS	M	new maintenance level			

RAILROAD COMPANY: INPUT EXPLANATION FORM

Type of Decision	Code	Decision Maker	a	b	c	d	e
Purchase or bid on land	$PU	RAIL	Location	price (in $1000's)	seller (economic decision-maker or department and jurisdiction or OU)	percent of parcel (0 if all)	
Build rail lines	$RAIL	RAIL	list of two intersections separated by commas	list of parcels in parentheses from which land is required if line is above ground; if subway, leave blank.			
Build stations	$RAIL	RAIL	location of station				
Purchase stock	$OTHER	RAIL	PS	number of units of equipment			
Sell stock	$OTHER	RAIL	SS	number of units of equipment			
Change fares	$OTHER	RAIL	P	base fare per worker per journey (in ¢)	0	price per mile (in ¢)	

Type of Decision	Code	Decision Maker	a	b	c	d	e
Change salaries	$OTHER	RAIL	S	new salary to middle income worker (specified as salary per worker in $100's)			
Change maintenance level	$OTHER	RAIL	M	new maintenance level			
Transfer	$CASH	RAIL	C	receiver (economic decision-maker or department and jurisdiction)	amount (in dollars)	from CAPital or CURrent account	if economic decision-receiving, PVT; if department receiving, to CAPital or CURrent account
Change level of service	$ROUT	RAIL	Route number	old level of service	new level of service (0 if eliminating route)	list of stations (in parentheses)	0

VIII. MASTER SHEETS

The Master Sheets contained in this chapter summarize all the numerical parameters necessary for participating in the game. It is hoped that once players have familiarized themselves with the earlier portions of this manual, they can use this and the preceding chapter as reference points when finalizing their decisions.

MASTER TABLE FOR ECONOMIC TEAMS

LIMITATIONS ON DEBTS	
MAXIMUM AMOUNT OF DEBT	80% OF NET WORTH
NORMAL RANGE OF OUTSIDE INTEREST RATES	4.3% to 6.2%
NORMAL RANGE OF RATES OF RETURN ON	
SPECULATIVE STOCK	-1 to 10%
CONSERVATIVE STOCKS	5 to 7%
NORMAL RANGE OF PRICE RELATIVES	
HEAVY INDUSTRIES	.90 to 1.12
LIGHT INDUSTRIES	.93 to 1.10
NATIONAL SERVICES	.95 to 1.06

	RANGE FOR CONSTRUCTION COSTS (Millions of $)	RANGE FOR LAND REQUIREMENT (Percent of a Parcel
DEVELOPMENTS (LEVEL ONE)		
HEAVY INDUSTRY		
SURFACE WATER USERS	240-300	28-48
MUNICIPAL WATER USERS	140-320	12-40
LIGHT INDUSTRY		
SURFACE WATER USER	120-250	6-28
NATIONAL SERVICES	50	12
LOCAL COMMERCIAL	20-45	10-12
RESIDENCES (100 Quality Index)	1-25	2

Economic Boycotts*

Possible Boycotting Activities	Activities that Can Be Boycotted
FL, SG, MP, MF, NL, EL, TE, FO	
TA, PA, CR	
NS, PG,PS	BG, BS
RA, RB, RC	PB, PS

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*This does not include any social boycotts that might be directed against economic teams. For example population units may boycott working at any economic employment location or shopping at any PG or PS establishment.

Outside System Taxes on all Developments

Income Taxes

State - 5% of gross income minus all expenses except water, utilities, transportation, this tax and federal income tax

Federal - 22% of first $25,000 and 48% of above $25,000 on gross income minus all expenditures except water, utilities, transportation, and this tax

Sales Taxes

3% State sales tax applied against purchases of goods and services (from BG, BS, PG and PS, and purchases from the Outside by BG and BS)

MASTER TABLE FOR INDUSTRIAL ESTABLISHMENTS
(LEVEL ONE CHARACTERISTICS)

	FL	SG	MP	MF	NL	EL	TE	FO	TA	PA	CR	NS
LOCATION REQUIREMENTS												
1. PERCENT OF PARCEL (Maximum Possible Levels)	28 (3)	40 (2)	48 (2)	20 (5)	15 (6)	12 (8)	12 (8)	20 (5)	6 (16)	16 (6)	28 (3)	12 (8)
2. ZONING REQUIRED	-- 00 10 20 21	-- 00 10 20 21	-- 00 10 20 21	-- 00 10 20 21	-- 00 10 20 21	-- 00 10 20 21	-- 00 10 20 21	-- 00 10 20 22	-- 00 10 20 22	-- 00 10 20 22	-- 00 10 20 22	-- 00 10 30 31
3. MINIMUM LEVEL OF UTILITY SERVICE	1	1	7	1	1	2	2	3	1	3	4	1
4. ANNUAL UTILITY UNITS CONSUMED	50	100	700	100	100	200	200	300	100	300	400	76
5. CONSTRUCTION COSTS (Millions of Dollars)	300	240	240	320	150	140	180	230	120	250	250	50
DEPRECIATION												
6. ANNUAL PERCENTAGE (Due to Aging)	3.0	2.0	4.0	3.5	3.0	4.0	5.0	2.0	1.5	1.5	3.0	3.0
7. MS EFFECT (Maximum Percentage)	3.0	2.0	4.0	3.0	3.0	4.0	5.0	2.0	2.0	2.0	3.0	3.0
8. FIRE (Maximum Percentage)	3.0	2.0	4.0	3.5	3.0	4.0	5.0	2.0	1.5	1.5	3.0	3.0
9. FLOOD	Depends upon amount input by director and location in flood plai											
FLOOD MULTIPLIER	.6	.6	.6	.6	.6	.6	.6	.5	.5	.5	.5	
10. WATER QUALITY (Maximum)	1.0	NA	1.0	NA	NA	NA	NA	1.0	1.0	1.0	1.0	
WATER CHARACTERISTICS												
11. SURFACE WATER USER	x		x					x	x	x	x	
12. CONSUMPTION (MGD)	60	10	225	9	12	5	8	49	17	333	31	.19
13. DAYS IN OPERATION PER YEAR	260	260	260	260	260	260	260	260	260	260	260	260
14. CONSUMPTION (MGY)	15860	2600	58500	2340	3120	1300	2080	12740	4420	86580	8060	46.8

MASTER TABLE FOR INDUSTRIAL ESTABLISHMENTS (LEVEL ONE CHARACTERISTICS) continued.

	FL	SG	MP	MF	NL	EL	TE	FO	TA	PA	CR	NS
15. RECYCLING												
COST PER MG	200	NA	200	NA	NA	NA	NA	200	200	200	200	NA
MAXIMUM PERCENT OF WATER ABLE TO BE RECYCLED	100	NA	100	NA	NA	NA	NA	100	100	100	100	NA
16. EFFLUENT TREATMENT CONSTRUCTION COST PER LEVEL (Millions of Dollars)												
CL	.5	NA	.8	NA	NA	NA	NA	.45	.2	1	.3	NA
PT	5	NA	8	NA	NA	NA	NA	4.5	2	10	3	NA
ST	45	NA	72	NA	NA	NA	NA	40.5	18	90	27	NA
EMPLOYEES												
17. FULL TIME POPULATION UNITS (P1's)												
PH	8	14	19	24	21	30	25	15	15	23	24	23
PM	8	18	18	18	20	18	22	19	10	17	24	9
PL	35	23	18	17	18	17	15	24	30	20	14	9
18. PART TIME (Leisure Time Units)												
PH	0	80	80	80	80	80	80	0	0	80	80	80
PM	80	160	160	160	80	80	80	80	0	0	80	0
PL	240	160	320	160	160	160	80	80	240	160	80	0
CAPACITY MEASURES												
19. MAXIMUM EMPLOYMENT EFFECT	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
20. MAXIMUM UNITS PRODUCED	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
INCOME FACTORS												
21. NORMAL PRICE PER UNIT SOLD (Thousands of Dollars)	196	155	176	232	147	200	184	148	100	183	185	100
22. TYPICAL INCOME FROM SALES (Millions of Dollars)	196	155	176	232	147	200	184	148	100	183	185	110

MASTER TABLE FOR INDUSTRIAL ESTABLISHMENTS (LEVEL ONE CHARACTERISTICS) continued.

	FL	SG	MP	MF	NL	EL	TE	FO	TA	PA	CR	NS
EXPENDITURES												
23. BUSINESS GOODS (Units)	400	200	140	300	100	400	200	30	20	100	150	60
24. BUSINESS SERVICES (Units)	120	40	35	180	54	246	174	10	10	44	50	23
25. PURCHASES PER 1% MAINTENANCE												
BG UNITS	10	8	10	8	8	6	10	5	4	4	4	1
BS UNITS	2	1	4	4	4	4	6	2	2	2	5	4
26. TYPICAL UTILITIES COSTS (Millions of Dollars)	.5	1.0	7.0	1.0	1.0	2.0	2.0	3.0	1.0	3.0	4.0	.76
27. WATER (Millions of Dollars)												
RECYCLING (Assuming 100% recycled)	3.17	NA	11.70	NA	NA	NA	NA	2.55	.88	17.32	1.61	NA
INTAKE PROCESS (Assuming Water Quality of 4)	1.59	NA	5.85	NA	NA	NA	NA	1.27	.44	8.66	.81	NA
OUTFLOW TREATMENT (Operating Costs)												
CL ($1000)	397	NA	1463	NA	NA	NA	NA	319	111	2165	302	NA
PT	1588	NA	5852	NA	NA	NA	NA	1276	444	8660	808	NA
ST	3176	NA	11704	NA	NA	NA	NA	2552	888	17320	1616	NA
TT	4764	NA	17556	NA	NA	NA	NA	3828	1332	25980	2424	NA
MUNICIPAL SUPPLY (Assuming water costs of $450 per MG) (Millions of Dollars)	NA	1.17	NA	1.05	1.40	.59	.94	NA	NA	NA	NA	.02
28. TRANSPORTATION (Per Unit of Output on Type 3 Road)												
TO BG	2500	6000	7000	2700	7000	1000	2500	1000	5000	2000	2000	1250
TO BS	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1250
TO TERMINAL	2500	2000	2000	1500	1000	500	1500	1000	500	1500	1000	NA
TERMINAL UNITS	1000	10000	6000	2000	1000	1000	2000	3000	1000	3000	3000	NA

MASTER TABLE FOR INDUSTRIAL ESTABLISHMENTS (LEVEL ONE CHARACTERISTICS) continued.

	FL	SG	MP	MF	NL	EL	TE	FO	TA	PA	CR	NS
. SALARIES (Full Employment)	Depends upon Salary levels offered.											
. TAXES												
PROPERTY	Local rate times assessed value											
SALES	Fixed state sales tax times purchases of goods and services											
INCOME	Federal-State tax plus local tax, if any											
. RATE OF RETURN	Net income divided by sum of business value and land value											
. UNITS OF POLLUTION PER MG												
BOD (LBS/MG)	600	500	1000	500	400	800	500	6000	6000	3000	2000	100
CHLORIDES (LBS/MG)	100	100	170	150	150	200	180	400	130	380	600	0
NUTRIENTS (LBS/MG)	1000	1000	500	700	100	200	100	10000	4000	3000	800	0
COLIFORM (Parts/MG)	20	10	20	30	20	20	30	300	20	150	50	20
TEMPERATURE DEVIATION	9	0	6	0	0	0	0	9	18	16	4	0
OIL & FLOATING SOLIDS	1	0	1	1	0	0	0	1	1	1	1	0
HIGH LEVEL WASTES	0	0	0	0	0	0	0	0	1	1	1	0
. INTAKE TREATMENT COSTS PER MG (dollars)												
QUALITY OF WATER												
1	10	NA	20	NA	NA	NA	NA	50	20	20	30	NA
2	60	NA	60	NA	NA	NA	NA	60	60	60	60	NA
3	80	NA	80	NA	NA	NA	NA	80	80	80	80	NA
4	100	NA	100	NA	NA	NA	NA	100	100	100	100	NA
5	180	NA	180	NA	NA	NA	NA	180	180	180	180	NA
6	300	NA	300	NA	NA	NA	NA	300	300	300	300	NA
7	450	NA	450	NA	NA	NA	NA	450	450	450	450	NA
8	600	NA	600	NA	NA	NA	NA	600	600	600	600	NA
9	Cannot be used.											

MASTER SHEET FOR THE CONSTRUCTION INDUSTRY

Land Development	
Development Cost (equipment units)	$120,000,000
Land Requirement	20%
Depreciation (equipment	
As a Function of Use	.04C*
Capacity (equipment units)	1000
Expenditures	
Employment Requirements	1 population unit of each class per 50 units of labor
Typical Wage Bill (if typical salaries of $10,000, $5,000 and $2,500 are offered)	$2,500,000 per 50 units of labor
Per unit of Equipment	
BG	.44 units
BS	.06 units

NOTE: BG and BS may be purchased either from local BG and BS establishments at competitive prices or from the "Outside System" at "fixed cost" of $130,000 per units.

Transportation Charges per mile along HY3 per CU of Construction	
to BG:	$220
to BS	30
to Build Site	60

NOTE: A HY3 is the least expensive road to travel. Costs are double on a HY2 and triple on a HY1.

Taxes	
Local	
Property Sales	Local Tax Rates are set by the Chairman
Federal and State	
Business Income (State)	5% of (gross income minus salaries, minus goods and services payments, minus maintenance payments, minus state sales tax and local sales tax, and minus property tax).
Business Income (Federal)	22% of first $25,000 of (gross income minus salaries, minus goods and services payments, minus maintenance payments, minus local sales tax, minus state sales tax, minus property tax, minus state income tax) plus 48% of rest (minus the same deductions).
Sales Tax (state)	3% of the total purchases of BG and BS.

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* $C = \frac{\text{equipment units used}}{\text{design capacity}}$

MASTER SHEET FOR THE CONSTRUCTION INDUSTRY

Construction Capacity Requirements

Land Use	Construction Units of Equipment	Units of Material	Units of Labor	Demolition Units of Equipment	Demolition Units of Material
Basic Industry					
HI1	525	525	525	105	359
LI1	325	325	325	65	222
NS1	250	250	250	50	171
Local Service Industry					
BG1	125	125	125	25	86
BS1	50	50	50	10	34
PG1	150	150	150	30	103
PS1	50	50	50	10	34
Residences*					
RA1	5	5	5	1	3
RB1	30	30	30	6	21
RC1	125	125	125	25	86
Public Structures					
SC1	135	135	135	27	92
MS1	150	150	150	30	103
HY1	4	4	4	1	3
TM1	70	70	70	14	42

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*These requirements of equipment, materials, and labor are for residence construction at QI = 100. But new housing can be built at a lower quality index (as low as QI = 40). Requirements diminish according to the equation: $R = 1/200\ S(100 + X)$ where S is the units of equipment and material or the units of labor required to build a residence at QI = 100 and R is the units required to build the same type of residence at QI = X. Using an RC1 as an example, the requirements at QI = 80 are 113, at QI = 60 are 100, and at QI = 40 are 80.

MASTER TABLE FOR COMMERCIAL ESTABLISHMENTS
(LEVEL ONE CHARACTERISTICS)

		BG	BS	PG	PS
LOCATION REQUIREMENTS					
1.	PERCENT OF A PARCEL CONSUMED	12	10	12	12
	(Maximum Possible Levels)	(8)	(10)	(8)	(8)
2.	ZONING REQUIRED	-- 00 10 30 32	-- 00 10 30 33	-- 00 10 30 34	-- 00 10 30 35
3.	MINIMUM LEVEL OF UTILITY SERVICE	2	1	1	1
	(Annual Utility Units Consumed)	112	71	99	77
4.	CONSTRUCTION COST (millions of Dollars)	25	10	30	10
	DEPRECIATION				
5.	ANNUAL PERCENTAGE (Due to Aging)	1.5	2.0	1.6	2.2
6.	MS EFFECT (Maximum Percentage)	2.5	3.0	2.6	3.2
7.	FIRE (Maximum Percentage)				
8.	FLOOD (Maximum Percentage)				
	Flood Multiplier	1.5	1.4	1.3	1.2
9.	USE (Percentage at 100% Use)	1.5	2.0	1.6	2.2
	WATER CONSUMPTION				
10.	MILLIONS OF GALLONS PER DAY (MGD)	.13	.17	.23	.18
11.	DAYS WATER IS USED PER YEAR	310	310	310	310
12.	MILLIONS OF GALLONS PER YEAR (MGY)	41	53	72	56
	EMPLOYEES				
13.	FULL TIME POPULATION UNITS (P1's)				
	PH	14	20	8	6
	PM	7	9	13	11
	PL	8	9	23	16
14.	PART TIME (Leisure Time Units)				
	PH	80	80	0	0
	PM	0	0	80	80
	PL	0	0	160	160

		BG	BS	PG	PS
	CAPACITY MEASURES				
15.	MAXIMUM EMPLOYMENT EFFECT	5000	1500	16000	8000
16.	MAXIMUM EFFECTIVE CAPACITY	5000	1500	16000	8000
17.	NORMAL PRICE PER CAPACITY UNIT SOLD (Thousands of Dollars)	100	100	10	10
18.	TYPICAL INCOME FROM SALES (Millions of Dollars)	500	150	160	80
	EXPENDITURES				
19.	BUSINESS GOODS (Units)	NA	NA	.037/CU	.03/CU
20.	BUSINESS SERVICES (Units)	NA	NA	.017/CU	.01/CU
	OUTSIDE SERVICE CHARGES (Thousands of Dollars)	83/CU	58/CU	NA	NA
21.	PURCHASES PER 1% MAINTENANCE				
	BG UNITS	NA	NA	2	.75
	BS UNITS	NA	NA	1	.25
	OUTSIDE SERVICE CHARGES (Thousands of Dollars)	250	100	NA	NA
22.	TYPICAL UTILITIES COSTS (Millions of Dollars)	1.12	.71	.99	.77
23.	WATER (Assuming Water Costs = $450)	18135	23715	32085	25110
24.	TRANSPORTATION UNITS* (Per Unit of Capacity on HY3)				
	TO BG	NA	NA	.0425	.0375
	TO BS	NA	NA	.02	.0125
	TO TERMINAL	1	NA	NA	NA
25.	SALARIES (Full Employment)	Depends upon salary levels offered			
26.	TAXES				
	PROPERTY	Local rate times assessed value.			
	SALES	Fixed state sales tax times purchases of goods and services.			
	INCOME	Federal-state tax plus local tax, if any.			
27.	RATE OF RETURN	Net income divided by sum of building value and land value.			

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*One Transportation Unit Cost $400.00

MASTER TABLE FOR RESIDENCES
(LEVEL ONE CHARACTERISTICS)

LOCATION REQUIREMENTS	RA	RB	RC
1. PERCENT OF PARCEL CONSUMED	2	2	2
2. (Maximum Possible Levels of Development)	(50)	(50)	(50)
3. ZONING REQUIRED	-- 00 40 41	-- 00 40 42	-- 00 40 43
4. MINIMUM LEVEL OF UTILITY SERVICE REQUIRED	1	1	2
5. (Annual Utility Units Consumed)	(4)	(26)	(117)
CONSTRUCTION FACTORS			
6. COST (millions of dollars)	1	6	25
7. QUALITY INDEX (When new, equal to or greater than)	40	40	40
DEPRECIATION			
8. ANNUAL (Due to aging)	2.0	3.0	4.0
9. MS EFFECT (Maximum)	2.0	3.0	3.0
10. FIRE (Maximum)	2.0	2.0	2.0
11. FLOOD (Maximum depends upon damage set by director and location on flood plain)			
12. (Flood Multiplier)	(1.1)	(1.0)	(.9)
WATER CONSUMPTION (Depends Upon Occupants)			
13. MGY PER PH	29	25	22
14. MGY PER PM	25	18	11
15. MGY PER PL	11	11	7

	RA	RB	RC
16. NUMBER OF DAYS DURING YEAR WATER IS USED	360	360	360
17. MGD PER PH	.08	.07	.06
18. MGD PER PM	.07	.05	.03
19. MGD PER PL	.03	.03	.02
OCCUPANTS			
20. SPACE UNITS PROVIDED	2	12	50
21. SPACE UNITS DEMANDED:			
PH	2	2	2
PM	1.5	1.5	1.5
PL	1	1	1
RENT PER SPACE UNIT (Thousands of dollars)			
22. MAXIMUM	210	210	210
23. NORMALS FOR VARIOUS CLASSES			
PH	165	165	165
PM	150	150	150
PL	140	140	140
INCOME (Assuming 100% Occupancy) (Thousands of Dollars)			
24. AT MAXIMUM RENT	420	2520	10500
25. AT RENT OF $150,000 PER SPACE UNIT			
PH OCCUPANTS	300	1800	7500
PM OCCUPANTS	300	1800	7500
PL OCCUMPANTS	300	1800	7500
EXPENDITURES			
26. MAINTENANCE			
PG UNITS PER 1% MAINTENANCE	.7	4	17
PS UNITS PER 1% MAINTENANCE	.3	2	8
NORMAL TOTAL COSTS PER 1% MAINTENANCE	10	60	250
27. NORMAL UTILITIES CHARGES (Thousands of dollars)	40	260	1170

28. TAXES

PROPERTY	(Local rate times assessed value)
INCOME	(Federal-state tax plus local tax)
SALES	(Local rate times purchases for maintenance)

NET INCOME	Income from rent minus expenditures
RATE OF RETURN	Net income divided by sum of residence value and land value
ENVIRONMENTAL INDEXES	Comprised of pollution index plus residence quality, rent, MS and school use indexes, and taxes or welfare

FARM MASTER TABLE

Farm Identification	F1	F2	F3	F4	F5
Percent Increase in Net Income as a Function of the Fertilizer Level					
1	7	8	5	3	2
2	12	16	9	7	5
3	20	25	15	12	9
Polution of Nutrients (in LBS/MG) as a Function of the Fertilizer Level					
0	40	50	30	20	10
1	80	100	60	40	20
2	160	250	90	80	30
3	320	500	180	160	60

PLANNING MASTER TABLE
(LEVEL ONE CHARACTERISTICS)

ACTIVITY	Percent of a Parcel	Maximum Possible Levels	Minimum Level of Utility Service	Annual Utility Units Consumed	Construction Costs (Market Value)	Full Time Employees			Terminal Units	MS Drain (MS Capacity Units)
						PH	PM	PL		
FL	28	(3)	1	50	300	8	8	35	1000	150
SG	40	(2)	1	100	240	14	18	23	10000	50
MP	48	(2)	7	700	240	19	18	18	6000	200
MF	20	(5)	1	100	320	24	18	17	2000	150
NL	15	(6)	1	100	150	21	20	18	1000	100
EL	12	(8)	2	200	140	30	18	17	1000	150
TE	12	(8)	2	200	180	25	22	15	2000	200
FO	20	(5)	3	300	230	15	19	24	3000	250
TA	6	(16)	1	100	120	15	10	30	1000	150
PA	16	(6)	3	300	250	23	17	20	3000	200
CR	28	(3)	4	400	250	24	24	14	3000	300
NS	12	(8)	1	76	50	23	9	9	NA	50
BG	12	(8)	2	112	25	14	7	8	One per CU sold	25
BS	10	(10)	1	71	10	20	9	9	NA	10
PG	12	(8)	1	99	30	8	13	23	NA	30
PS	12	(8)	1	77	10	6	11	16	NA	10
RA	2	(50)	1	4	1	NA	NA	NA	NA	10
RB	2	(50)	1	26	6	NA	NA	NA	NA	60
RC	2	(50)	2	117	25	NA	NA	NA	NA	250

PLANNING MASTER TABLE
(LEVEL ONE CHARACTERISTICS)

MASTER TABLES FOR SOCIAL TEAMS

POPULATION UNIT MASTER TABLE

	PH	PM	PL
General Characteristics			
Population	500	500	500
Workers	120	160	200
Students	[illegible]	140	100
Education Range	70-99	40-69	0-39
Registered Voters	200	140	100
Mobility Characteristics			
Selection of Movers			
Random Movers	7%	5%	1%
Most Dissatisfied	(Half of the 20% with highest Quality of Life Index)		
Percent of Unemployed	33	25	15
Percent of Underemployed	33	25	NA
Selection of Housing Criteria			
Housing QI Range Considered	71-100	40-100	20-70
Maximum Occupancy Considered	120%	120%	120%
Environment Index	(lowest index value is most preferred)		
Characteristics of In-Migrants from Outside			
Education Level	85	55	15
Voter Registration	200	140	100
Previous Saving	0	0	0
Time Allocation			
Extra Job	20	30	40
Public Adult Education	0	30	20
Private Adult Education	20	5	0
Politics	40	20	10
Recreation	10	10	20
Income Characteristics			
Workers per Pl	120	160	200
Full Employment Salary	(salary per worker times number of workers)		
Part-time Salary	(80 time units provides full-time salary)		
Welfare	(Local jurisdiction payment per worker times the number of unemployed workers)		
Miscellaneous	(cash transfers from other accounts)		

POPULATION UNIT MASTER TABLE continued.

	PH	PM	PL
Expenditure Characteristics			
Rent			
Rent Paid Factor	2.00	1.33	1.00
Space Units Consumed	2	1.5	1
Transportation			
Maximum Percent of Salary willing to be spent to get a Job Costs per Worker for Job	10%	15%	25%
Auto			
Base Auto Cost	$210	$190	$140
Cost per HY Link (uncongested)			
HY3	$100	$ 87	$ 75
HY2	$125	$112	$100
HY1	$150	$137	$125
Public Transit	(fare set by transit authority)		
Maximum P1's per RR1	50	40	30
Maximum P1's per BUS 1	25	20	15
Unit Public Transit Consumed	2	2.5	3.3
Travel to PG (and to PS)			
Base Cost per CU	$ 50	$ 50	$ 50
Cost per CU Consumed (along HY3) (along HY2 is twice as much and along HY1 is three times as much)	$125	$125	$125
	(These commercial transporation costs are only incurred if purchases are made from local suppliers).		
Normal PG Consumption (CU's)	34	28	21
Additional CU's of PG for each time unit in recreation	.1	.05	.025
Normal PS Consumption (CU's)	16	11	7
Additional CU's of PS for each time unit in recreation	.075	.05	.0
Schooling of Children			
Criteria for Attending Public School			
Minimum School Value Ratio	80	60	None
Maximum Ratio of Students/Teacher	18	22	None
Minimum Ratio of PH Teachers to PM	1.0	.75	None

POPULATION UNIT MASTER TABLE continued

	PH	PM	PL
Cost of Private Education (per full P1)	$39,000	$24,500	$12,500
Cost Per Student	$300	$175	$125
Schooling of Adults			
Cost per Time Unit Allocated to Private Adult Education	$3,000	$3,000	NA
Health Expenditures (per P1)			
Base Amount	$8,000	$4,000	$2,000
Coliform PARTS/MG greater than 100	$400/Part	$200/Part	$100/Part
Coliform PARTS/MG less than 100	$160/Part	$80/Part	$40/Part
Taxes			
Sales Tax			
State	(3% of the dollar amount of PG and PS purchases)		
Local	(depends upon the rates set by the local jurisdiction of PG and PS separately)		
Income Tax			
Federal (on salaries)	8%	4%	1%
Local	(set by the local jurisdictions)		
Automobile Taxes	(depends upon rates levied - jurisdiction of residence and/or work)		
Miscellaneous Expenses	(cash transfers to other accounts in the social, economic, or government sector)		
Time Allocation (total time units)	100	100	100
Auto Transportation (uncongested)			
Per link HY3	2.5	2.5	2.5
Per link HY2	5.0	5.0	5.0
Per link HY1	7.5	7.5	7.5
Bus Transportation			
Waiting	1	1	1
Along HY3	5.0	5.0	5.0
Along HY2	7.5	7.5	7.5
Along HY1	10.0	10.0	10.0

POPULATION UNIT MASTER TABLE continued

	PH	PM	PL
Rapid Rail Transportation	2.5	2.5	2.5
Waiting	1	1	1
Walking	2.5	2.5	2.5
Illness	(health index for the parcel on hwich the Pl's residence is located divided by 10)		
Extra Job	(80 units of part-time work is equivalent to a full-time job)		
Education			
Time Units Required to maintain the Highest Level	32	24	30
Time Units Required to Maintain the Education Level Specified in the Parenthesis	16(80) 24(90) 32(99)	12(50) 18(60) 24(69)	12(10) 18(20) 24(30)
Typical Decline in Educational Level if No Time is Allocated for Adult Schooling	2	2	2
Allocation Typically Needed for Stay at Present Level	16	12	18
Politics - Units of Time Required to Increase Voter Registration	(increases in voter registrations last for only one round)		
7%	10	10	10
10%	50	50	50
15%	60	60	60
Water Consumption (MG)			
Daily if living in			
RA	.08	.07	.03
RB	.07	.05	.03
RC	.06	.03	.02
Annually if living in			
RA	29	25	11
RB	25	18	11
RC	22	11	7

Congested roads at peak-hours (all to work trips) cause an increase in the dollar and time costs of automobile usage. For example, a road that is 25% congested (utilized 125%) will cost 25% more in both money and time for those workers who use it.

QUALITY OF LIFE FACTORS FOR POPULATION UNITS

	PH	PM	PL
Health Index			
Maximum Value	100	100	100
Poor MS	(MS Use Index - 100) ÷ 4; Maximum = 25		
Residence Crowding	(% Occupancy - 100) ÷.8; Maximum = 25		
Coliform Index	PARTS/MG ÷ 4; Maximum = 50		
Time Index			
Transportation Time Consumed			
AUTO - Waiting	0	0	0
HY3	2.5	2.5	2.5
HY2	5.0	5.0	5.0
HY1	7.5	7.5	7.5
BUS - Waiting	1	1	1
HY3	5.0	5.0	5.0
HY2	7.5	7.5	7.5
HY1	10.0	10.0	10.0
RAIL - Waiting, any level, Walking (per segment)	1	1	1
Recreation	(Maximum = 0, minimum = -100		
Involuntary	(Desired time in extra job and public adult education minus actual time in extra job and public adult education); Maximum = 100.		
Pollution Index	Value printed for that parcel of land on which the residence is located; Maximum = + 166; Minimum = -16.		
Neighborhood Index			
QI of Housing	100-QI	90-QI	70-QI
Rent	(Rent-$330,000)2(Rent-$200,000)3(Rent-$140,000)		
MS Use Index	MS Use Index - 100; Maximum = 100		
School Use Index	School Use Index - 100; Maximum =100		

QUALITY OF LIFE FACTORS FOR POPULATION UNITS continued

	PH	PM	PL
Tax Rates in Local Jurisdiction			None
Each mil or resident income	.25	.25	
Each mil on goods	.25	.25	None
Each mil on services	.25	.25	None
Each mil on land	.125	.125	None
Each mil developments	.125	.125	
Welfare Payment for each $100 below $2,000	None	None	4

Health Index + Time Index = Personal Index

Pollution Index = Neighborhood Index = Environment Index

Personal Index = Environment Index = Quality of Life Index

MASTER SHEET FOR THE SCHOOL DEPARTMENT

General Characteristics

	SC1
Land Development	
Typical Construction Cost	$27,000,000
Land Requirements	16%
Depreciation and Maintenance	
Annual Depreciation Rate	2%
BG and BS Requirements	
For 1% Renovation or Maintenance	
BG	2 units
BS	.7 units
For Normal Operation	
BG	8 units
BS	3 units
Federal-State Aid	
Capital	$1 for every local $1
Current (automatic)	$225 per student

Design Capacity (students) as a Function of Employment Mix

PM Teacher Units PH Teacher Units	0	1	2	3	4	5	6
0		2,520	4,140	6,840	9,900	12,240	13,140
1	3,600	5,910	8,460	11,200	13,320	15,300	17,100
2	7,200	9,900	12,600	15,500	17,460	19,440	21,240
3	10,800	14,040	16,920	20,000*	21,960	23,760	25,560
4	13,140	17,460	21,060	23,400	25,200	27,000	28,620
5	17,100	20,700	23,400	26,640	28,440	30,000	31,500
6	19,800	23,850	26,820	29,880	31,320	32,850	34,200

*The least cost design capacity of an SC1

Note: There are 120 teachers in a PH and 160 teachers in a PM.

Population Unit Characteristics

Characteristics	PH	PM	PL
Number of students	130	140	100
Criteria for Refusal Attend Public Schools Value Ratio (Min.)	80	60	
Student-Teacher Ratio (Maximum)	18:1	22:1	
Ratio of High to Middle Teachers (Minimum)	1:1	3:4	
Cost of Private Education (for students)	$37,500	$25,000	$12,500

Capital Federal-State Aid

1st Request: 60% chance of acceptance when students/school = 18,000

2nd Request: 40% chance of acceptance when students/school = 18,000

3rd Request: 30% chance of acceptance when students/school = 18,000

Adult Education

School Demand

EAD Time unit allocated to public adult education is a unit of demand.

School Supply

Classes held in public school facilities - only additional cost is for part-time teachers.

One Unit of Time by P1 Hired	Provides Units of Adult Education
PH	15
PM	10

MASTER SHEET FOR THE CHAIRMAN
PLANNING MASTER TABLE
(LEVEL ONE CHARACTERISTICS)

Department	Basis			Limit on Number of Requests per Jurisdiction	Probability of Receipt
School					
Current Aid	$225/student			NA	Automatic (no request needed)
Capital Aid	Match dollar for dollar			3	60% (1st request) 40% (2nd request) 30% (3rd request)
Highways	Type of Road	Matching Federal	Matching Local		
Capital Aid	I	$1	$9	5 road segments	80%
	II	$1	$1		50%
	III	$2	$1		
Municipal Services					
Current Aid	Two Federal-State dollars for each local dollar up to maximum total paid of $35 per resident of the jurisdiction			NA	Automatic

OPERATION OF FEDERAL-STATE AID

MASTER SHEET FOR MUNICIPAL SERVICES DEPARTMENT

General Characteristics

Land Development	MS 1
Typical Construction Cost	$30,000,000
Land Requirement	12%
Depreciation and Maintenance	
Annual Depreciation Rate	3.3%
BG and BS Requirements	
For 1% Renovation or Maintenance	
BG	2 units
BS	1 unit
For Normal Operation	
BG	7 units
BS	3 units

Design Capacity (MS units) as a Function of Employment Mix

PM Worker Units \ PL Worker Units	0	1	2	3	4	5	6
0		140	230	380	500	680	730
1	200	330	470	630	740	850	950
2	400	550	700	860	970	1,080	1,180
3	600	780	940	1,100*	1,220	1,320	1,420
4	730	970	1,170	1,300	1,400	1,500	1,590
5	950	1,150	1,300	1,580	1,580	1,670	1,750
6	1,100	1,325	1,490	1,660	1,740	1,825	1,900

Note: There are 160 workers in a PM and 200 workers in a PL.

*The least cost design capacity of MS1

Drain on Municipal Services

See Planning Master Table, the last column for drain on MS (page 244).

MASTER TABLE FOR THE HIGHWAY DEPARTMENT

(Characteristics for Level One Unless Stated Otherwise)

Facility	Highways (HY)	Terminals (TM)
Location Requirements		
Percent of Parcel	(from both sides)	(from 4 corners)
Level 1	8	12
Level 2	12	16
Level 3	16	20
Construction Costs		
(Millions of Dollars)	.8	14
Depreciation		
Due to Use	5.0 Z a)	NA
Road Maintenance		
Purchases per 1% Maintenance	$20,000/segment	NA
Capacity Measures		
Design Capacity (standardized units)	500/segment	10,000
Consumption by Users (standardized units)		
P1	10	
BUS (level 1)	50	
BG		1 per CU sold
FL, NL, EL, TA		1,000
MF, TE		2,000
FO, PA, CR		3,000
MP		6,000
SG		10,000

Federal-State Aid for Capital Construction

Road Type	Matching Federal	Local	Probability of Receiving Aid
Level 1	$1	$9	80%
Level 2	$1	$1	50%
Level 3	$2	$1	30%

Limit on the number of road segments requested by a jurisdiction is 5.

Note a): Z = highway units used/effective capacity and, effective capacity is the design capacity times the value ratio expressed as a percent.

PLANNING MASTER TABLE
(LEVEL ONE CHARACTERISTICS)

ACTIVITY	Percent of a Parcel	Maximum Possible Levels	Minimum Level of Utility Service	Annual Utility Units Consumed	Construction Costs (Market Value)	Full Time Employees PH	PM	PL	Terminal Units	MS Drain (MS Capacity Units)
FL	28	(3)	1	50	300	8	8	35	1000	150
SG	40	(2)	1	100	240	14	18	23	10000	50
MD	48	(2)	7	700	240	19	18	18	6000	200
MF	20	(5)	1	100	320	24	18	17	2000	150
NL	15	(6)	1	100	150	21	20	18	1000	100
EL	12	(8)	2	200	140	30	18	17	1000	150
TE	12	(8)	2	200	180	25	22	15	2000	200
FO	20	(5)	3	300	230	15	19	24	3000	250
TA	6	(16)	1	100	120	15	10	30	1000	150
PA	16	(6)	3	300	250	23	17	20	3000	200
CR	28	(3)	4	400	250	24	24	14	3000	300
NS	12	(8)	1	76	50	23	9	9	NA	50
BG	12	(8)	2	112	25	14	7	8	One per CU sold	25
BS	10	(10)	1	71	10	20	9	9	NA	10
PG	12	(8)	1	99	30	8	13	23	NA	30
PS	12	(8)	1	77	10	6	11	16	NA	10
RA	2	(50)	1	4	1	NA	NA	NA	NA	10
RB	2	(50)	1	26	6	NA	NA	NA	NA	60
RC	2	(50)	2	117	25	NA	NA	NA	NA	250

PLANNING MASTER TABLE
(LEVEL ONE CHARACTERISTICS)

OPERATION OF FEDERAL-STATE AID

Department	Basis	Matching Federal	Matching Local	Limit on Number of Requests per Jurisdiction	Probability of Receipt
School					
Current Aid	$225/student			NA	Automatic (no request needed)
Capital Aid	Match dollar for dollar			3	60% (1st request) 40% (2nd request) 30% (3rd request)
Highways	Type of Road	Federal	Local		
Capital Aid	I	$1	$9	5 road segments	80%
	II	$1	$1		50%
	III	$2	$1		30%
Municipal Services					
Current Aid	Two Federal-State dollars for each local dollar up to maximum total paid of $35 per resident of the jurisdiction			NA	Automatic

OPERATION OF FEDERAL-STATE AID

PLANNING MASTER TABLE
(LEVEL ONE CHARACTERISTICS)

ACTIVITY	Percent of a Parcel	Maximum Possible Levels	Minimum Level of Utility Service	Annual Utility Units Consumed	Construction Costs (Market Value)	Full Time Employees PH	PM	PL	Terminal Units	MS Drain (MS Capacity Units)
FL	28	(3)	1	50	300	8	8	35	1000	150
SG	40	(2)	1	100	240	14	18	23	10000	50
MP	48	(2)	7	700	240	19	18	18	6000	200
MF	20	(5)	1	100	320	24	18	17	2000	150
NL	15	(6)	1	100	150	21	20	18	1000	100
EL	12	(8)	2	200	140	30	18	17	1000	150
TE	12	(8)	2	200	180	25	22	15	2000	200
FO	20	(5)	3	300	230	15	19	24	3000	250
TA	6	(16)	1	100	120	15	10	30	1000	150
PA	16	(6)	3	300	250	23	17	20	3000	200
CR	28	(3)	4	400	250	24	24	14	3000	300
NS	12	(8)	1	76	50	23	9	9	NA	50
BG	12	(8)	2	112	25	14	7	8	One per CU sold	25
BS	10	(10)	1	71	10	20	9	9	NA	10
PG	12	(8)	1	99	30	8	13	23	NA	30
PS	12	(8)	1	77	10	6	11	16	NA	10
RA	2	(50)	1	4	1	NA	NA	NA	NA	10
RB	2	(50)	1	26	6	NA	NA	NA	NA	60
RC	2	(50)	2	117	25	NA	NA	NA	NA	250

PLANNING MASTER TABLE
(LEVEL ONE CHARACTERISTICS)

ZONING MASTER TABLE

Allowable Uses

Code	HI	LI	NS	BG	BS	PG	PS	RA	RB	RC	Park Land
--	X	X	X	X	X	X	X	X	X	X	
00	X	X	X	X	X	X	X	X	X	X	
10	X	X	X	X	X	X	X				
20	X	X									
21	X										
22		X									
30			X	X	X	X	X				
31			X								
32				X							
33					X						
34						X					
35							X				
40								X	X	X	
41								X			
42									X		
43										X	
50											X

HI includes F1, SG, MP, MF, NL, EL, TE

LI includes FO, TA, PA, CR

PARKS MASTER TABLE

Demand for Recreational Space

One PH, PM, or PL is equal to 500 units of recreational demand.

Supply of Recreational Space

One percent of a land parcel devoted to parkland provides 250 units of recreation supply.

One percent of a land parcel devoted to public institutional land provides 500 units of recreation supply.

Park Use Index (for a parcel with either or both types of parks) $= \dfrac{\text{units of recreation demand}}{\text{units of recreation supply}}$

PLANNING MASTER TABLE
(LEVEL ONE CHARACTERISTICS)

ACTIVITY	Percent of a Parcel	Maximum Possible Levels	Minimum Level of Utility Service	Annual Utility Units Consumed	Construction Costs (Market Value)	Full Time Employees PH	PM	PL	Terminal Units	MS Drain (MS Capacity Units)
FL	28	(3)	1	50	300	8	8	35	1000	150
SG	40	(2)	1	100	240	14	18	23	10000	50
MP	48	(2)	7	700	240	19	18	18	6000	200
MF	20	(5)	1	100	320	24	18	17	2000	150
NL	15	(6)	1	100	150	21	20	18	1000	100
EL	12	(8)	2	200	140	30	18	17	1000	150
TE	12	(8)	2	200	180	25	22	15	2000	200
FO	20	(5)	3	300	230	15	19	24	3000	250
TA	6	(16)	1	100	120	15	10	30	1000	150
PA	16	(6)	3	300	250	23	17	20	3000	200
CR	28	(3)	4	400	250	24	24	14	3000	300
NS	12	(8)	1	76	50	23	9	9	NA	50
BG	12	(8)	2	112	25	14	7	8	One per CU sold	25
BS	10	(10)	1	71	10	20	9	9	NA	10
PG	12	(8)	1	99	30	8	13	23	NA	30
PS	12	(8)	1	77	10	6	11	16	NA	10
RA	2	(50)	1	4	1	NA	NA	NA	NA	10
RB	2	(50)	1	26	6	NA	NA	NA	NA	60
RC	2	(50)	2	117	25	NA	NA	NA	NA	250

PLANNING MASTER TABLE
(LEVEL ONE CHARACTERISTICS)

MASTER SHEET FOR THE UTILITY DEPARTMENT

General Characteristics

Level of Service	Installation Costs (million)	Number of Utility Units Installed
1	2	100
2	4	200
3	5	300
4	6	400
5	8	500
6	11	600
7	14	700
8	18	900
9	35	2,500

Operating Costs for a UT1 as a Function of the Number of Utility Units Served

Utility Units Served	Per Unit Operating Costs	Total Operating Costs
300	$20,000	$6,000,000
600	13,333	8,000,000
900	9,630	8,666,667
1200	7,778	9,333,333
1500*	6,667*	10,000,000*
1800	7,407	13,333,333
2100	7,936	16,666,666
2200	8,080	17,777,778

*The least cost desing capacity of a UT1.

UTILITY DEPARTMENT MASTER TABLE

	Utility (unit)	Water (MG)
Normal Price of Service	$10,000	[1]

	Utility Plant	Utility Level	Intake	Outflow
Cost of Lowest Level Plant (millions)	$30	$2	$.1 - 4.5	$.1 - 4.5[2]
Capacity	2400	100		3 MGD
Typical Operating Cost Per Capacity Unit	$7,000 to $8,000		0 - $600[3]	$25 - 300[2]
Land Requirement	6%	None	1%	1%

Intake Treatment Costs per MG

	Water Quality Level								
	1	2	3	4	5	6	7	8	9
UT	5	60	80	100	180	300	450	600	NA

Annual Cost to Operate an Ambient Water Quality Sampling Station $50,000

Annual Cost to Operate a Point Source Water Quality Sampling Station $25,000

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[1] Water prices may be set by type of user.

[2] Depending upon treatment type.

[3] Depending upon water quality.

CHARACTERISTICS OF OUTFLOW TREATMENT PLANTS

Pollution Characteristics of Economic Activities

	Level of Treatment Plant							
	1	2	3	4	5	6	7	8
Maximum Capacity (MGD)	3	8	16	26	40	60	90	200
Land Requirement (% of Parcel)	1	2	3	4	5	6	7	8
Construction Costs (millions of dollars)								
CL	.1	.2	.4	.6	.8	1.0	1.2	1.6
PT	.5	1.0	2	3	4	5	6	8
ST	1.5	3.0	6	9	12	15	18	24
TT	4.5	9.0	18	27	36	45	54	72
Operating Costs (dollars per MG)								
CL	25	24	23	22	21	20	19	18
PT	100	95	90	85	80	75	70	65
ST	200	190	180	170	160	150	140	130
TT	300	285	270	255	240	225	210	195

Intake treatment plants have the same construction costs as ST outflow treatment plants.

Percent Pollution Removed by Treatment Types

	CL	PT	ST	TT
BOD	0	50	80	99
Chlorides	0	0	60	99
Nutrients	0	0	50	70
Coliform	99	99	99	100
Temperature	0	0	0	100
Oil & Floating Solids	0	100	100	100
High Level Wastes	0	0	0	100

MASTER SHEET FOR BUS COMPANY AND RAIL COMPANY

General Characteristics

Characteristics	BUS	RAIL
Land Development		
Typical Development costs		
Underground tracks		$14,000,000/mi.
Surface tracks		4,000,000/mi.
Stations		1,000,000
Land requirements		4% surface tracks (for one side only)
Operating Expenses		
Fixed cost of equipment per mile	$400,000 (40 units)	$800,000 (80 units)
Employment		
Typical cost of labor per mile	40,000	40,000
Units of labor required per mile	50	50

NOTE: Bus and Rail hire middle income (PM) workers only. There are 160 workers in a PM. The typical salary per worker is $5,000. One PM supplies 1,000 units of labor and 50 units of labor are required to operate a bus (level 1) and rail (level 1) for one mile.)

	BUS	RAIL
Depreciation & maintenance of equipment		
Average rate (annual	3.5%	3.5%
BG and BS requirements for 1% renovation or maintenance		
BG	$40/unit of equipment	$40/unit of equipment
BS	$60/unit of equipment	$60/unit of equipment
Passenger Capacity (people)		
When value ratio = 100		
Level 1 Route	3,000	6,000
Level 2 Route	6,000	12,000
Level 3 Route	9,000	18,000

Distance for Diagonal Rapid Rail Segments

Horizontal Distance Between Stations

Vertical distance between stations		1	2	3	4	5
	1	1.414	2.236	3.162	4.123	5.099
	2	2.236	2.828	3.606	4.472	5.385
	3	3.162	3.606	4.243	5.000	5.831
	4	4.123	4.472	5.000	5.657	6.403
	5	5.099	5.385	5.831	6.403	7.071

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16. Abstracts

City 4 is an operational simulation game in which participants make economic, government, and social decisions affecting a hypothetical metropolitan area. Through the use of a computer, the simulated urban system responds to the participant's decisions as any real city would. Each player in City 4 is assigned to a team which shares an economic and governmental role. This manual describes the player details for the economic and government sectors along with general information required for game play. It is one of three manuals necessary for game play. (Player's Manual, Director's Manual, Computer Operator's Manual). Each of these manuals are designed to be used for reference and by themselves will not describe enough details for a complete game play. The game is run on an IBM O.S./360 computer.

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17b. Identifiers/Open-Ended Terms

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